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MARKETING RESEARCH REPORT NO. 321

Export

EXPORT SHIPPING TESTS to Europe

with Florida Citrus Fruit

Europe

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Marketing Research Division

WASHINGTON, D. C.

PREFACE

This study of shipping Florida citrus fruit to Europe is part of a broad program of research to achieve more efficient distribution of our farm products. One phase of this research is concerned with evaluation, improvement, and maintenance of the quality of food in transit and in marketing channels.

Changes in kind of containers for packing Florida citrus fruit and in shipping practices and ship facilities introduced problems in transit refrigeration that made it desirable to conduct tests to determine the effect of fruit quality, kind of package, loading temperature, transit temperature, and fungicidal treatment on condition of the fruit at destination.

Information obtained in this study has indicated the causes of spoilage and shown how losses can be reduced and quality improved.

A preliminary report on the results of these tests was published in the January 1956 issue of Marketing Activities. This is a more detailed report.

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The following importers or their agents cooperated in these tests: Jack M. Berry & Company, Jan van den Brink, G. L. van Gelderen, A. van Hoboken & Son, International Fruit Company (Kamstra Brothers), Gerard Konicks Freres, Leon van Parys, B. M. Spiers & Sons, Jac. Vandenberg, Inc. (H. Pasch), and Velleman & Tas.

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SUMMARY AND RECOMMENDATIONS

A study was initiated with Florida oranges and grapefruit export shipments in the fall of 1954 to determine the effect of quality of fruit packed, kind of package, precooling, fungicidal treatments, and temperatures on board ship on condition of the fruit at destination. Eight shipping tests were made from Florida ports and one with Florida citrus loaded at New York. All shipments from Florida were in refrigerated holds. In the shipment from New York some of the holds were refrigerated and some were ventilated.

Sea and air temperatures in the Florida shipments averaged in the seventies at the start and about 50° F. at the end of the voyage. Temperatures for the New York shipment were lower at the start but about the same as the Florida shipments at the end. Temperature in the ventilated hold of the New York shipment averaged about 50°. Temperatures in a refrigerated hold of the same ship were 11° to 20° lower.

Fruit temperatures during loading varied widely depending on precooling and handling practices. They ranged from 45° to 90° in the New York shipment and from 35° to 74° in Florida shipments.

Refrigeration of the cargo during the voyage varied widely depending on temperature of the fruit when loaded and temperature of the air circulated through the hold. All ships, even the older ones, seemed to have sufficient refrigeration capacity to maintain suitable temperatures when the fruit was adequately precooled before loading. Even the new ships were unable to lower the temperature quickly in fruit that was warm when loaded.

Cartons varied considerably in their resistance to damage. Common faults were glue or staple failure, tearing of the handhold, and buckling in lower layers of cargo.

Quality and condition of the fruit when loaded was generally good, but some individual lots were poor because of rust mite injury, melanose, mechanical damage, green mold in warm lots, poorly applied color-added treatment, rind breakdown, aging, and pitting.

Condition of the fruit at destination varied considerably. This was due to some extent to different temperatures during shipment and different treatments, but much of it seemed due to differences in the initial quality of the fruit. Some general conclusions are--

a. Rind breakdown was worse in grapefruit shipped in the refrigerated hold than in the ventilated hold.

b. Rind breakdown was more prevalent and severe in color-added oranges than in natural color lots.

c. Decay was reduced by treating the fruit with sodium orthophenylphenate-hexamine, use of diphenyl treated wraps, liners, or cartons for packing, and by a combination of both sodium orthophenylphenate-hexamine and diphenyl. Diphenyl seemed to increase rind breakdown under some conditions.

Simulated shipping tests were conducted under controlled conditions at Orlando to determine the effect of various temperature exposures on the fruit. Results of these tests indicated that--

a. Oranges will keep as well for 6 weeks at 38° F. as for 2 weeks at 50° or 1 week at 60°.

b. Grapefruit stored for 3 weeks at 50° F. and then for 2 weeks at 38° and 1 week at 70° developed less rind breakdown and decay than grapefruit stored initially at 38°.

It is recommended that--

1. Better quality fruit be packed for export.

2. Oranges be precooled to below 40° F. as rapidly as possible after packing and protected from warming while moving from precooling rooms or refrigerated cars or trucks to ship's holds.

3. Temperatures in the ships' holds be maintained at about 35° F. for oranges and 50° for grapefruit.

4. Fruit be treated with sodium orthophenylphenate-hexamine solution and packed with diphenyl treated packing materials to reduce decay.

EXPORT SHIPPING TESTS TO EUROPE WITH FLORIDA CITRUS FRUIT

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BACKGROUND

In February 1954, the citrus groves of Spain suffered a severe freeze which crippled production in that country for several years. Before this, Spanish growers had supplied a major share of the middle-European market.

The resulting scarcity made it possible for Florida shippers to increase fresh fruit sales greatly in this important foreign market. For several years after the freeze, Florida citrus fruit, mostly oranges, went to Europe at the rate of more than a million boxes annually. During the 1956-57 season, about 1.75 million boxes were shipped to Europe. This compares with an average annual shipment of less than 400,000 boxes before 1954.

Florida produces well over 20 percent of the world's orange crop and during the past few years has produced nearly 75 percent of the world's grapefruit crop. Yet the State has not become an important source of citrus fruit for European markets. Some of the reasons are: (1) Trade restrictions or sanctions imposed by governments are difficult to cope with and at times are insurmountable; (2) failure to pack fruit considerably above the minimum requirements of U. S. No. 1 Grade; (3) Florida citrus fruit is often subjected to abusive treatment before packing, to delayed or insufficient refrigeration during transit, and to unwise storage conditions in the markets; and (4) Florida citrus fruit must meet strong price competition, since it moves to market when fruit with excellent color is normally available from closer areas, such as the Mediterranean basin. Mexico, with its high quality orange of excellent appearance, is giving Florida serious competition that may increase.

Making delivery of sound fruit to a domestic market 3 days distant is one thing, and to a market 3 weeks away in Europe is quite another, calling for a different approach to the problem. In the past, shipments of Florida citrus fruit to Europe have sometimes reached destination in unsatisfactory condition. This results in heavy financial losses to the receiver. With the thought that overseas sales might be increased if better handling and transportation practices based on concrete experiments were used, the Florida Citrus Exchange and the Florida Citrus Mutual requested the U. S. Department of Agriculture to undertake shipping tests to determine how Florida citrus fruits should be handled to assure sound delivery at European markets and a reasonably long shelf life in the retail stores there.

In response to this request, the Department, in cooperation with the Florida Citrus Commission and the Florida Citrus Experiment Station, conducted 9 shipping tests to Rotterdam, The Netherlands, during the 1954-55 crop year. In these tests, studies were made on the effect of quality of fruit packed, kind of package, precooling, fungicidal treatments, and temperature on board ship on the condition of the fruit at destination. Tests also were conducted under controlled conditions at Orlando, Fla., on the effect of temperature and fungicidal treatments on decay and quality of fruit.

SHIPPING TESTS

Fruit Used in Tests

In the shipping tests, observations were made on fruit in the commercial cargo and on special test packages stowed in the commercial cargo. Most of the test packages were representative samples drawn from commercial lots being packed for overseas market. They were collected from 24 widely separated packinghouses. Fruit used in the decay inhibitor tests was treated under semi-commercial conditions at the Florida Citrus Experiment Station, Lake Alfred, and at the U. S. Horticultural Field Station, Orlando, Fla.

Temperature Equipment

Temperatures in transit were obtained by means of thermographs and electrical resistance thermometers. The thermographs were placed in test packages at the packinghouse and removed when the cargo was discharged at Rotterdam. These instruments automatically record time and temperature. Electrical resistance thermometers were used only on ships A and D. The bulbs of these thermometers were placed at desired locations during loading. They were read twice daily by personnel accompanying these shipments. Packages containing thermographs or resistance thermometers were placed in the bottom, middle, and top layers amidship, and in the middle layer on the port and starboard sides of each deck containing test lots of fruit. Thermographs were also placed in the air vents on both sides near the test packages. Test lots of oranges were included in all shipments, Temple oranges in 3, and grapefruit in 7. Sea temperatures were obtained from the ship's log. Outside air temperatures were taken from the same source when thermographs were not used for this purpose.

Types of Packages

The sudden shift from standard nailed boxes of 1 3/5-bushel capacity to the almost exclusive use of the 4/5-bushel cartons prevented extensive comparison of the two kinds of packages. In only the first test were there enough nailed boxes to make a dependable comparison. The fiberboard cartons used in all shipments were a 4/5-bushel ventilated telescope type that was more rigid than similar telescope cartons used in domestic shipments. Most of these cartons had the ends and bottom flaps of the inside units treated with diphenyl at the factory.

Handling Fruit Before Loading Aboard Ship

Test packages and commercial lots were transported by trucks from packinghouses to piers at Fort Pierce and Jacksonville, Fla., and to New York City. Various types of trucks were used, including those with stake sides and open tops (covered with a tarpaulin when necessary), and vans with and without ports for ventilation.

The fruit shipped out of New York City was transported directly from packinghouses in central Florida to that port in refrigerated and non-refrigerated trucks, and loaded aboard ship after several days' delay. Some lots, including one test lot of grapefruit, were held in the packinghouse several days before shipment to New York. The refrigerated loads received "standard refrigeration" enroute to New York but most arrived at shipside with commodity temperatures above 55° F.

At the Florida ports, the test and commercial lots of fruit were placed in shipside precooling rooms until loading time. In some instances as much as 22 hours elapsed between loading the truck at the packinghouse and unloading at the shipside precooling plant.

Kinds of Ships Used

Five vessels were used in these shipments. The non-precooled fruit loaded at New York City was shipped in ship A, a 5-hold general cargo vessel which had both refrigerated and ventilated chambers (fig. 1 A). It was a modern vessel of the C-2 class of 8,240

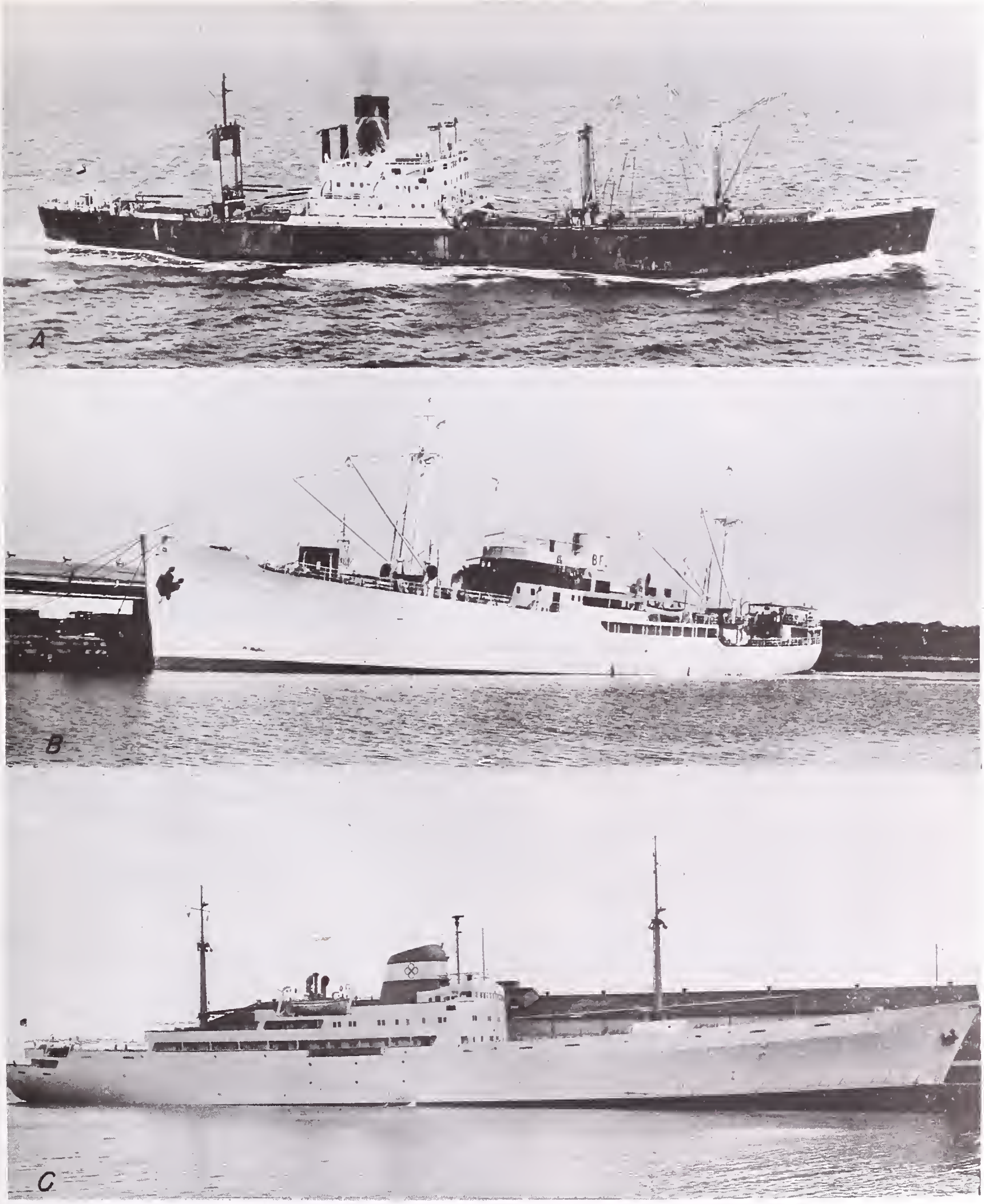

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Figure 1.--Kinds of ships used in tests.

A, Ship A, a modern cargo liner equipped with some refrigerated cargo space. The Florida ports are served by a few such ships bound for North Sea ports.

B, Ship B is typical of the prewar vessels commonly in use for transporting fresh meat and bananas.

C, Ship E was a newly-commissioned ship, receiving the test shipment of oranges and grapefruit as its first cargo.

gross tonnage. The refrigerated space in this ship was along the hull of 1 deck in 2 holds. The other 4 vessels ranged from 2,902 to 3,220 gross tonnage, were of the type generally used in the fresh meat and banana trades, and all holds were refrigerated. Ship B (fig. 1 B) was built in 1939 and Ship C in 1946. The two remaining ships were of more recent construction, Ship D having been built in 1951 and Ship E in 1955 (fig. 1 C).

In these vessels the cargo space varied from 100,000 to 130,000 4/5-bushel packages (or the equivalent). Each of the refrigerated ships had 4 holds with 4 decks in Nos. 1 and 2 holds. The 2 older ships had only 2 decks in the Nos. 3 and 4 holds, while 1 of the newer vessels had 3 decks in Nos. 3 and 4 holds, and the other had 4. Walk-in air tunnels (figs. 2 and 3) along the sidewalls of each deck of the vessels deliver and return air through small ports of 9 1/4 x 12 3/4 inches. Botton decks in the older vessels had only downspouts (fig. 4) which were spaced 4 1/2 feet center to center for delivering refrigerated air. In all ships, except ship B, horizontal boards attached to studding or ribs along the sidewall (fig. 5) prevented the stacking of packages flush against the sidewall, and provided vertical air channels or flues along the sidewall to aid in air distribution. The floors on each deck were solid, except for the C decks of Nos. 1 and 2 holds in ship B and ship C.

Floor racks on the older ships were 1 1/2-inch slats spaced 1 1/2 inches apart on 1 1/4-inch stringers, while those on newer ships were somewhat higher. Ship A had 4-inch floor racks in the refrigerated compartments, and dunnage strips 1 to 1 1/2 inches thick laid on the floor, serving as a floor rack in the ventilated decks. By comparison, in refrigerated rail cars, the clear space below the floor racks is 3 5/8 inches in cars with electric bunker bulkhead fans, 6 3/8 inches in cars with floor fans, and 4 7/8 inches in the mechanically refrigerated cars. All of the newer cars have vertical flues along the sidewalls to aid in air circulation.

The older ships had 6-inch cork insulation along the outer walls, and the newer ships had crinkled aluminum foil or glass wool 6 to 10 inches thick.

Ship B was refrigerated by direct expansion ammonia cooling coils running athwart the ship (fig. 6). The flow of air through the load was reversed at intervals by reversible propeller-type fans (fig. 7). The newer ships used Freon 12 as the refrigerant, and the flow of air was not reversed.

The 4 refrigerated chambers on ship A had a total capacity slightly under 32,000 cubic feet, and each chamber was provided with refrigeration by direct expansion of Freon 12. Each ventilated chamber on this ship was provided with two 18-inch fans powered by 1 1/2-horsepower motors.

In general, loading patterns which permit air flow through the lading were followed. Boxes were loaded on their sides, while cartons were stowed on their bottoms. The curvature of the hull made it necessary to vary the load pattern along the side. Cartons were stowed in the chimney pattern, mostly in 9 to 11 layers (fig. 8). On the lower deck, where the overhead was high, as in the older refrigerated ships, cartons were placed over 2 layers of boxes, separated by dunnage strips (fig. 4) to lessen the weight on the lower layers of cartons. In ship A the chimney stacks ranged between 7 and 9 layers high.

Courses of Ships

The course of the ships from Florida to the English Channel was first to 35° N. 73° .05' W. (Diamond Shoal Lightship), thence to 42° N. 50° W., a route which keeps them in relatively warm water, and on to 49° 50' N. 6° 27' W. (Bishop Rock). Those from New York start in much cooler water and move more directly to 42° N. 50° W., commonly called the "crossroads", and thence to Bishop Rock.

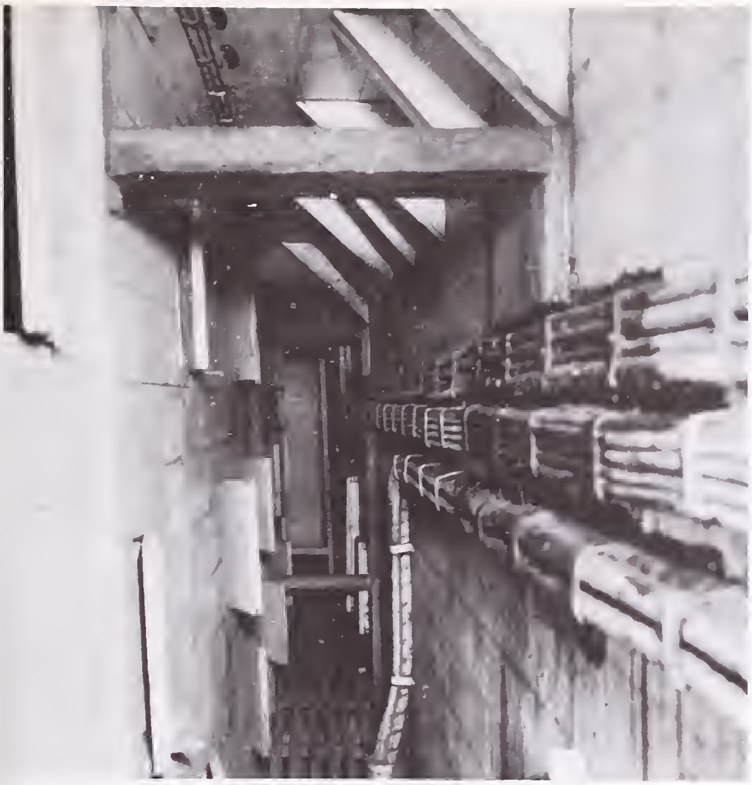

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Figure 2. --Air tunnel along the side of a prewar refrigerated ship. Air vents are shown on the left.

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Figure 3. --Research personnel point to air vents along the side of the top deck of a prewar ventilated ship, and also to a floor vent for movement of refrigerated air to the deck below.

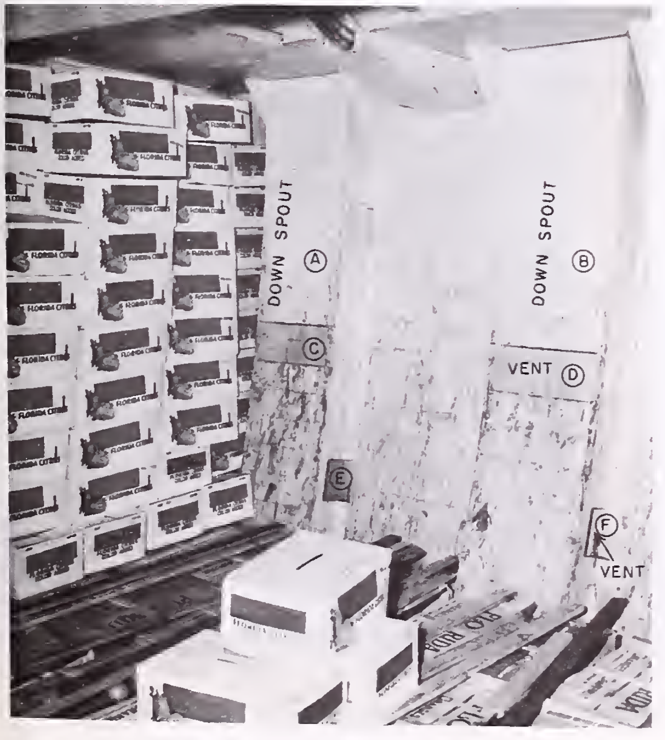

Figure 4. --Bottom deck. Positions of downspouts (A and B) from the top deck, and vents (C, D, E, and F) for the release of refrigerated air in the holds. Note that the 10 layers of cartons are stacked on top of 2 layers of nailed crates, with only thin dunnage strips used mainly as walkways for the longshoremen.

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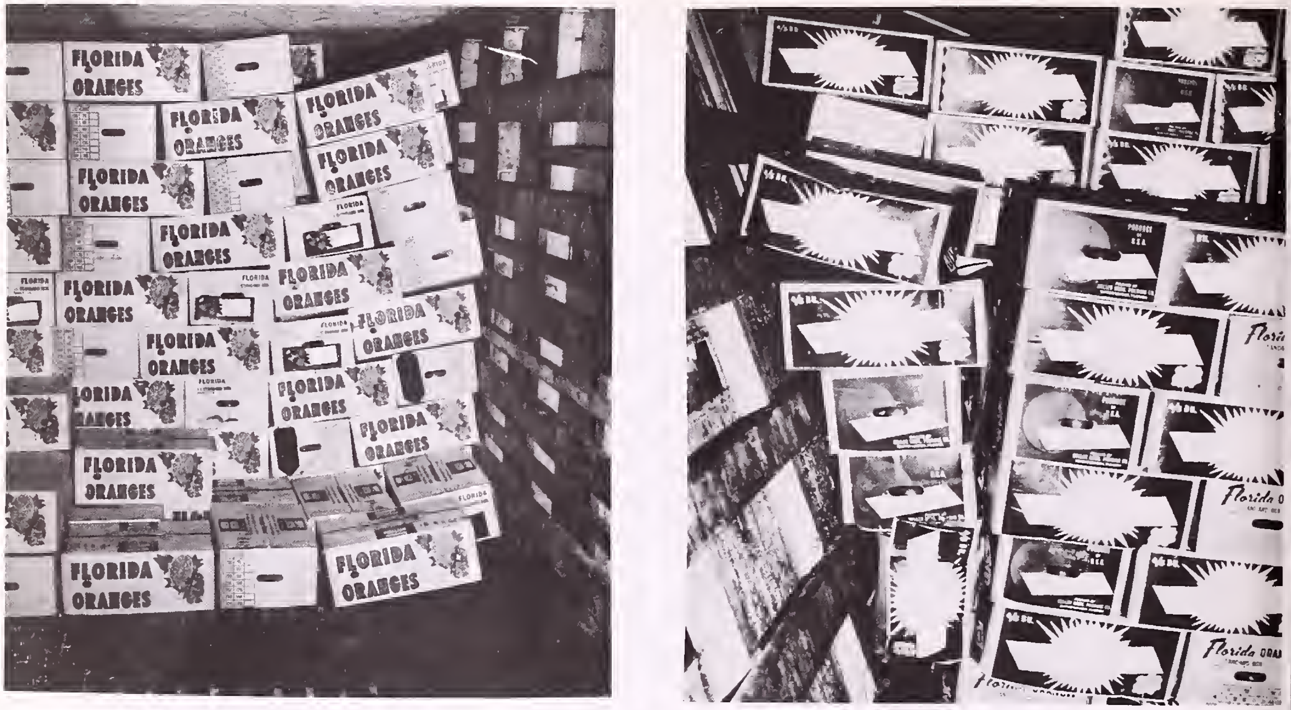

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Figure 5 --Natural curvature of the ship's sides causes the cartons of fruit to be placed in awkward positions which frequently damages packages. Note well-designed side racks that aid air circulation.

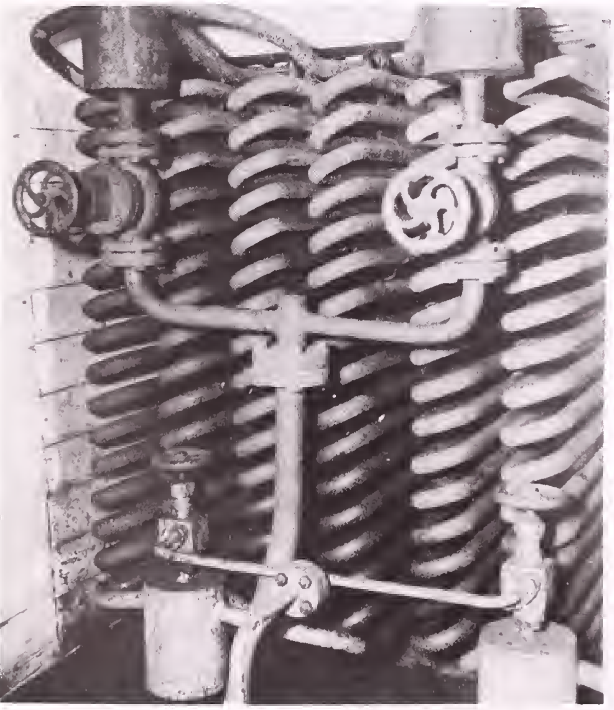

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Figure 6. --Ammonia refrigeration coils on ship B.

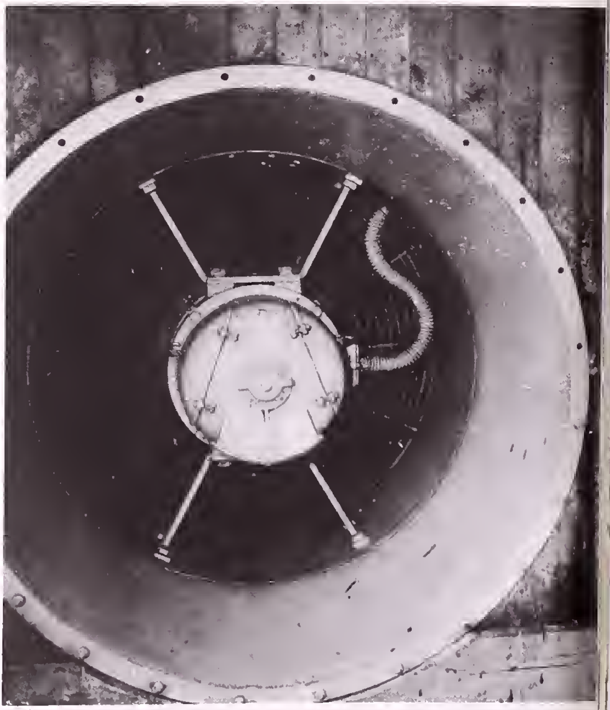

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Figure 7. --Reversible fans of this type are used for moving air throughout the ship.

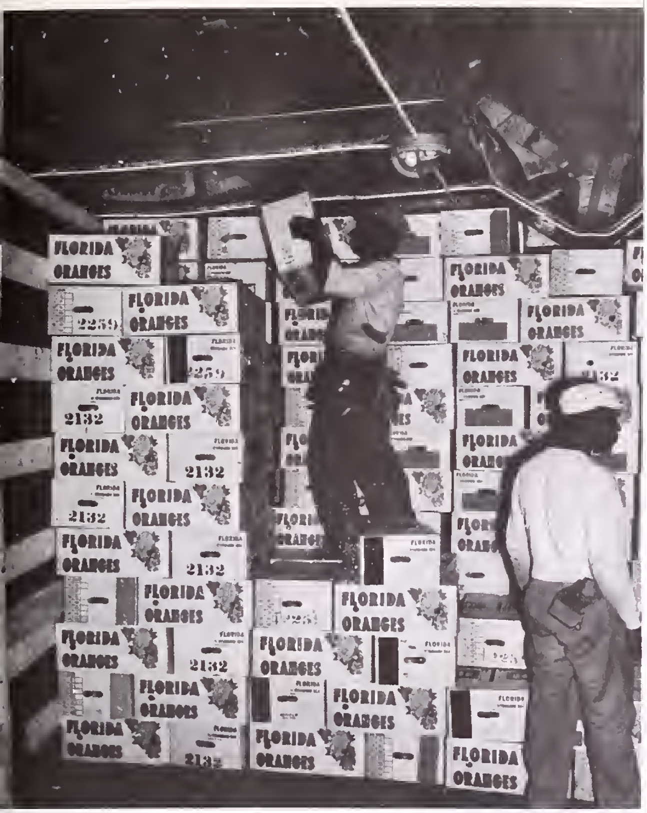

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Figure 8. --Modern vessel, showing aluminum ceiling and sidewall insulation, well-designed floor racks, with side racks that improve air circulation along the sides. Inadequately supervised workers are apt to stand on lower layers of cartons in placing cartons more than 9 layers high. This is often a major cause of fruit damage.

These cartons are being placed in a "chimney" stack that allows for air circulating space in the center.

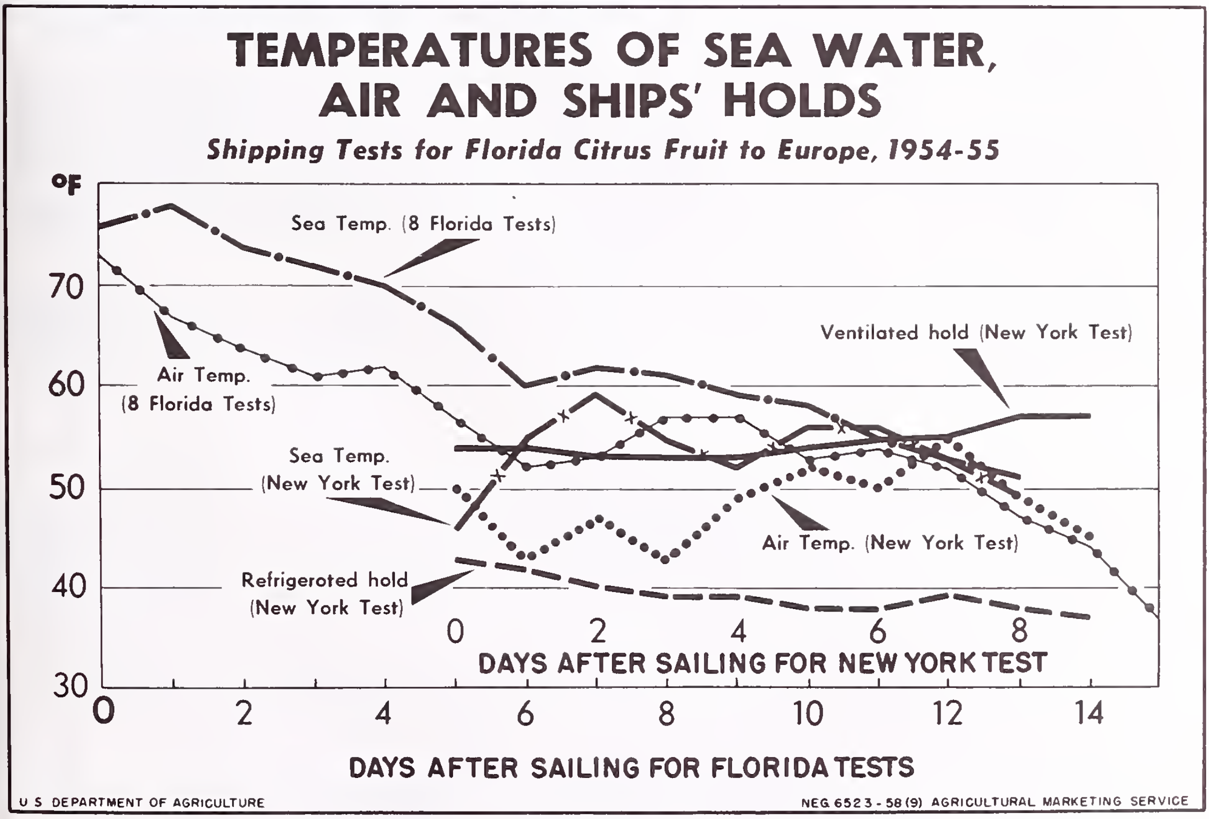

Figure 9.

Sea and Air Temperatures During Voyages

Sea temperatures were generally higher than the air temperatures, especially during the early part of the voyages when the ships from Florida were in the Gulf Stream (fig. 9). Sea and air temperatures for the shipments from Florida ports averaged in the seventies at the start and decreased to about 50° F. at destination. Average temperatures for the shipment from New York were lower than for the Florida shipments at the start since it was made in late March and it took about 2 days to get into the Gulf Stream. Temperatures during the latter part of the voyages were similar since the courses of both New York and Florida ships were the same from 42° N. 50° W. to destination.

Temperatures in the ventilated hold of the New York shipment roughly paralleled the sea temperatures and averaged about 50° F. Temperatures in the refrigerated hold were about 11° to 20° lower than in the ventilated hold.

Temperature of the Fruit

The average temperature of all fruit when packed was about 80° F. Fruit that was exported from New York was shipped to that port in ventilated and refrigerated trucks. The fruit in refrigerated trucks cooled during the 7 or 8 days in transit and at shipside and when loaded on the ship ranged from 45° to 57° and averaged 51° (table 1.) Temperatures of the ventilated fruit when loaded on the ship ranged from 49° to 90° and averaged 55.8°. It was mostly between 55° and 60°.

The fruit loaded on ships at Florida ports was precooled for 1 to 11 days in a dockside precooler. From 36 to 48 hours was required to cool to 60° F., and another 24 hours were required to reduce the temperature to 50°. The rate of cooling thereafter was considerably slower. Cooling was more rapid in crates than in cartons. The temperatures of the different lots varied considerably when loaded because of different lengths of time in the precooler and differences in operation of the precooling plant. Loading temperatures of different lots ranged from 35° to 74° F. The average loading temperature ranged from about 41° to 54° (tables 2-9).

The temperature of the air circulated through the cargo in the ventilated holds of the shipment from New York ranged from 45° to 58° F. as it entered the hold (table 1). When unloaded, the temperature of the fruit in these holds was 56° to 62° or 2° to 8° higher than when loaded. The air circulating through the refrigerated hold of the same ship was 33° to 36° as it entered the hold. It gradually lowered the temperature of the fruit from an average of about 51° at loading to 37° at destination.

The refrigeration of the shipments from Florida varied considerably. The temperature of the air as it entered the hold was 30° to 63° F. at the beginning of the voyage and 29° to 43° at destination. In general, the temperature of the fruit was lowered to within a few degrees of the air temperature.

The time required for the fruit to reach a desirably low temperature depended on the loading temperature of the fruit and the temperature of the air that was circulated through the hold.[1] Where the loading temperatures were low as on ship B (table 7), the ship, although an old one, was able to maintain good temperatures from the start. In the same ship, when the loading temperature of the fruit was high (table 9, Middle 2-C), the temperature did not reach 41° until the last 2 days of the voyage. Ship C, another of the older ships, was able to maintain satisfactory temperatures on one deck and fairly satisfactory temperatures on another when the loading temperature of the fruit was about 39° F. (table 5, Middle 2-B and 2-D). When the loading temperature was about 50°, fruit on one deck did not reach 41° until the last 2 days and on the other deck the temperature was 54° to 56° for nearly the entire voyage (table 8, Middle 1-C and 3-A). Ship D, a relatively new ship, took 9 to 12 days to reduce the temperature to 41°, when the loading temperature of the fruit ranged from 47° to 57° and averaged about 51° (table 2, Middle 2-B, 2-C and 2-D). The other new ship, ship E, which was loaded with fruit with a temperature of about 41°, reduced the temperature of the fruit to 31° to 34° during the voyage (table 3, Middle 4-A). These records indicate that the older ships can maintain satisfactory shipping temperatures provided the fruit is adequately cooled before loading, but that even the new ships have difficulty if the fruit is not cool enough.

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[1] In analyzing refrigeration performance of the ships, temperature data for the middle layers of the load are compared since this position is more representative of the bulk of the cargo. Temperatures in the top and bottom layers were usually several degrees lower.

Condition of the Packages

Cartons varied considerably in their ability to withstand the repeated handling incident to overseas shipment. Little failure was observed at shipping point, but at destination weaknesses showed up in the form of glue or staple failure, torn handholds, and buckled cartons in the lower layers. By contrast, cartons in California shipments held up well, possibly because of the support from their inner reinforcement.

Condition of the Fruit

Condition of the fruit in the commercial cargoes was observed as the ships were being loaded and unloaded to learn the general quality at the start, and changes that took place during the voyage. The experimental packages were inspected twice after unloading to note the changes that occurred during several weeks' storage incident to marketing at destination.

The quality and condition of the fruit was within grade and generally good at loading on all of the test ships except the last two which were loaded late in the season. On the last two the fruit was generally somewhat soft and unattractive due to drought.

Plugging, that is, a tear in the rind where the stem was pulled from the fruit during harvesting, was excessive in some lots. Some lots of non-precooled fruit showed considerable green mold. It also was present in some of the precooled fruit, which indicates that cooling was not rapid enough or sufficient to completely prevent development of mold to the visible stage before loading. Some stem-end rot also was observed at loading. Decay became progressively worse as the seasons for the several varieties advanced, but was generally not important enough at loading to throw any precooled lot out of grade. However, 1 or 2 lots of non-precooled fruit were rejected at shipside in New York because of excessive green mold.

Generally, color-added lots looked less attractive than the natural color lots on the same ships, especially toward the end of the season. This was largely because excessive application of the dye often gave the fruit an unnatural and lifeless appearance. Light applications of dye improved the appearance of tolerant fruit.

Rind breakdown, aging, and pitting varied in different lots of fruit and on the different ships but were generally not important at loading.

The condition of the fruit at destination varied considerably even on the same ship (tables 10-18). Some of the variation was associated with different temperatures during shipment and with different treatments, but much of it was due to differences in the initial quality of the fruit. Since most of the various lots of fruit were from different sources, very few direct comparisons may be made between the treatments. However, some general observations may be made.

Ventilation and refrigeration were compared on ship A (table 10) which sailed from New York. Rind breakdown of oranges was about the same under ventilation as under refrigeration. Rind breakdown of grapefruit was worse under refrigeration. This was to be expected as the temperature in the refrigerated hold was about 37° to 43° during most of the transit period--a temperature range that is very favorable to pitting. Decay in oranges was reduced by refrigeration. It was not important in grapefruit in these tests.

Both natural color and color-added oranges were shipped in 7 of the shipping tests, but only general observations may be made since in no case were the natural color and color-added oranges from the same lots of fruit. Rind breakdown seemed to be more frequent and severe in the color-added lots. Decay varied considerably and did not seem to be affected by the color-added treatment.

Decay inhibitor treatments tested included (1) diphenyl-treated cartons, wraps, and box liners, (2) sodium orthophenylphenate-hexamine, (3) combinations of diphenyl-treated packing materials and sodium orthophenylphenate-hexamine, (4) ethyl thionocarbamate, and (5) fungicidal wax emulsions. In only a few cases were different chemical treatments applied to lots of fruit that were otherwise comparable. Therefore, only a few direct comparisons may be made of the effect of the treatments. The data do, in general, indicate that decay may be reduced considerably by any of the treatments tested. They also suggest that diphenyl under some conditions may increase rind breakdown. Diphenyl-impregnated crate liners and cartons reduced decay in comparable lots of oranges (lots 103 and 104, table 15; lots 72 and 73, table 17; and lots 85 and 86, table 18). Ethyl thionocarbamate and sodium orthophenylphenate-hexamine treated oranges had much less decay than comparable lots of untreated oranges (lots 9, 10, 11, table 10; lots 46, 47, 48, 49, table 14; lots 56, 57, 62, 63, 64, table 16; lots 74-78, table 17; lots 87-91, table 18.

SIMULATED SHIPPING TESTS AT ORLANDO

Concurrent with as well as prior to the execution of the overseas shipping tests, a series of simulated shipping tests was conducted in the storage rooms at Orlando where temperatures could be controlled and recorded more accurately than in actual shipping tests. Early, midseason, and late oranges were stored at 38°, 50°, and 60° F. for varying lengths of time. Commercially graded and packed Marsh and Duncan grapefruit, size 80's, were stored between January and May for 3 weeks (simulating an overseas shipment) at 32°, 38°, 45° and 50° followed by holding periods at 38° and 70° (simulating warehousing and marketing periods at destination). In still another series of tests, grapefruit was stored in June for 3 weeks at 32° and 50°, followed by 2 weeks at 50° and 32°, and another period of 2 weeks at 60° F., simulating temperatures that may prevail during the 3-week transit period, the 2-week warehousing period, and finally a 2-week storage period by retail merchants. These data afford a scientific basis upon which exporters of Florida oranges and grapefruit may decide on matters pertaining to refrigeration temperatures and the life expectancy of fruit after withdrawal from low temperatures.

The oranges used in these tests were grown in central Florida. The early fruit was given the ethylene treatment commonly utilized at that season, whereas the midseason and late fruit was not treated. All test lots were graded, packed, and placed in the storage rooms without delay, and reached the desired temperature within about 24 hours.

The grapefruit in these tests were produced mostly in Polk County. They were commercially graded and packed and placed in the storage rooms maintained at different temperature levels. They were stored the day they were packed, which was the day of picking or the day after.

Oranges were inspected after storage to record decay development, and grapefruit were inspected for the development of rind breakdown and decay.

In the tests (table 19) with oranges the fruit kept as well for 6 weeks at 38° F. as it did for 2 weeks at 50° and for only 1 week at 60°.

After 1 week at 70°, decay in the fruit stored for 6 weeks at 38° was about equal to the decay in fruit stored for only 3 weeks at 50° and only 2 weeks at 60°. The benefits of 38° storage over 50° and 60° storage were less after 2 weeks at 70°. At each of the storage temperatures, decay increased progressively as the storage period was extended. Decay was excessive at the end of 2 weeks in fruit stored continuously at 60°, 70° and 80°.

Penicillium (green mold), with its ability to grow even at temperatures as low as oranges can be stored, was not as serious in the early pickings as in the later ones, while stem-end rot developed in larger proportions in the early (ethylene-treated) lots.

In the tests with grapefruit, the first series was run between January and May with Marsh and Duncan grapefruit stored at 32°, 38°, 45°, and 50° F. for 3 weeks, followed by 2 weeks of storage at 38°, then for 1 week at 70°. These temperatures were selected to simulate temperatures before loading and in transit and temperatures in storage and during marketing at destination.

The least amount and least severe rind breakdown developed in grapefruit of both varieties initially stored at 50° (table 20) and the most in that initially stored at 38°.

The lower initial storage temperatures, that is, 32° and 38° F., resulted in slower decay development (table 21). At the end of the cold storage period, decay was found in 5 to 6 percent of the fruit initially stored at 50° but only a trace was noted in fruit stored at 32° and 38°. But after 1 week at 70° there was more decay in the lots initially stored at 32° and 38°. This was especially true with fruit of the Duncan variety. Thus the lower temperatures seem to predispose the grapefruit to more rapid spoilage after it is placed at room temperature. Green mold (Penicillium) was responsible for most of the decay in grapefruit, with the highest percentages in the lots stored at the lower temperatures.

The second series of tests with grapefruit made a further comparison of 32° and 50° as initial storage temperatures for 3 weeks. This was followed by 2 weeks of storage at 50° F. for those lots initially held at 32°, and a similar exposure to 32° for the fruit initially held at 50°. After this 5 weeks of storage, all lots were held 2 weeks at 60°.

Only a slight amount of rind breakdown developed in the Marsh grapefruit at any of the temperatures (table 22). More developed in the Duncan grapefruit, and in that variety it was worse in the fruit initially stored at 50° than at 32°.

At the end of the initial storage period, considerably more decay was found in the lots initially stored at 50° than in those stored at 32° (table 23). At the end of the second period, decay had not advanced in fruit transferred from 50° to 32°, but it had increased in the fruit transferred from 32° to 50°. After a further 1 and 2 weeks at 60°, decay was high in all lots but higher in those stored at 50° during the second period. Decay was worse in the Marsh than in the Duncan variety. Again Penicillium (green mold) caused the greater part of the rot.

DISCUSSION

Generally speaking, citrus fruit (especially oranges) from the Mediterranean basin develops a color comparable with that of California fruit, which is richer and more attractive than that of fruit grown in central and southern Florida. This is a handicap that cannot be ignored if Florida wants a good share of the European market. To overcome this handicap an effort should be made to select more attractive fruit for export. Much of the small fruit now going to processing plants has a better appearance than much of the fruit going overseas.

In order to compete more successfully in the European market, Florida must ship fruit that can compete in appearance with fruit shipped from other areas. It will probably be necessary to pack fruit for export that is considerably better in quality than the average U. S. No. 1 grade of fruit that is now shipped. This grade permits too wide a range in appearance to be attractive enough to compete with other citrus on the European markets. The fruit for export should show less damage from scars and blemishes, especially those caused by rust mite and melanose, and all fruit should be at least "fairly well colored".

Plugging or tears in the rind at the stem, while not very common in commercial lots, are occasionally excessive. Color-adding, both early and late in the season, is not always done with sufficient care. At times too much color was applied, at others too much heat. The Valencia orange is not as tolerant to this color treatment as the Hamlin, for example.

The first 3 weeks of the post-harvest life of exported Florida fruit is spent in packinghouses and precoolers and en route to Europe. During that time, much trouble can and frequently does develop, unless the fruit is handled carefully and kept at favorable temperatures all the way from the tree to the European market.

During most of the season when Florida normally would be exporting to Europe, the weather in Europe is cool enough to keep oranges in common storage without refrigeration for a moderate length of time, but is probably too cold for long storage of grapefruit.

Excessive delays between picking and getting the fruit to a safe temperature result in decay which often shows up in appreciable proportions when the fruit is being loaded aboard ship. Since lower temperatures are required to check green mold (a fast developing rot) than to hold down stem-end rot, the need for prompt cooling is greater in the cooler months when green mold is active.

Refrigeration facilities aboard ship are not designed with sufficient capacity for precooling and can hardly be expected to remove more than 1° to 2° a day from the cargo when it is loaded at temperatures around 50° F.

The rise in temperature in some of the test lots after loading (ships B and C) is strong evidence that much of the commercial fruit was considerably warmer than test lots on the same deck. The slowness with which the fruit on these decks cooled is also strong evidence that the refrigeration facilities aboard these ships are not adequate for rapid cooling.

The ship's hold should be, but is not always, cold before loading is started. Since ship refrigeration facilities are inadequate for precooling, the fruit should be cooled to a few degrees below the desired transit temperature before loading--especially in warm weather. This degree of precooling of fruit in cartons can be achieved in perhaps less than 4 or 5 days in most precooling rooms, provided warm fruit is not continually fed into the same room during this interval. The practice of sometimes loading partially precooled or even warm oranges invites trouble, especially when a significant amount of fruit with a temperature above 50° is placed on one deck. This practice is especially disastrous when green mold is active.

Some provision for getting a more even distribution of air through the load seems desirable. To achieve this, higher floor racks, flues along the sidewall, and a more open load would help.

Some cartons used for Florida fruit did not hold up well, suggesting that some of the materials used were not adequate for export containers. By contrast, cartons used for shipping California fruit to Europe held up better than those from Florida. Better supervision of loading is needed at the sides of the hold where curvature of the hull makes a systematic arrangement of the cartons difficult. There were indications that in some cases diphenyl had not been applied uniformly to the cartons or in a sufficient amount.

At loading as well as at destination, the color-added oranges showed more rind breakdown and not uncommonly more decay than the natural color fruit.

The rind breakdown found on Pineapple oranges was in the nature of scattered pits, while that found on Hamlin and Valencia oranges was for the most part located in the stem area. The latter condition is often referred to as "aging." Some aging was found in the first shipments of Hamlins and Valencias, which sailed November 23 and March 14, respectively. It increased as the season advanced and was most prevalent in the last shipment, which sailed May 20.

Florida grapefruit has not been delivered in the market places in Europe in a uniformly sound condition, mainly because of the development of scattered pitting. This condition is more often associated with exposure to intermediate refrigeration temperatures than with either 32° or 50° F. temperatures. The blemish, usually negligible when the ship was unloaded, sometimes caused serious damage within a few days.

Florida grapefruit does not lend itself to long storage even at optimum temperatures. Low temperatures seem to make the rind susceptible to pitting and green mold rot, and high temperatures favor stem-end rot. Usually, temperatures well below 50° F. and well above 32° are less satisfactory than either 32° or 50° continuously. Probably the most satisfactory storage temperature is 50° for no longer than 3 weeks. Storage at 32° for an additional few weeks thereafter seems preferable to 32° for the entire transit period and storage at destination.

Simulated shipping tests under controlled temperatures at Orlando emphasized the importance of quickly cooling oranges to the desired temperature. They also emphasized the fact that the shelf life of oranges decreases as the storage period lengthens.

The simulated grapefruit shipping tests indicated that overseas shipments that are likely to be stored for a few weeks before loading should be shipped at temperatures around 50° F. and stored overseas at 32°. More decay occurred when they were shipped at 32° and stored at 50°. These tests were made with ripe fruit. Results may be different with grapefruit in early stages of legal maturity.

For Florida oranges, including Temples, 38° is a satisfactory transit temperature. A temperature of 32° is more satisfactory but is more difficult to attain in transit and is more expensive.

The tests with diphenyl-treated tissue, liners, and cartons in general showed that diphenyl treatment would reduce decay but that it sometimes increased rind breakdown.

Although refrigeration is effective in retarding decay, it has no residual effect, and decay increases when the fruit is removed from cold storage and held at higher temperatures. The obvious need for supplemental protection by a fungicide when oranges are placed in warmer locations is shown in table 19.

Grapefruit are not so tolerant to low temperatures as oranges (tables 21 and 23). The lots initially stored for 3 weeks at temperatures below 40° F. seemed to develop more Penicillium rot and total decay when transferred later to 60° or 70° than those originally stored at temperatures above 40°. Whenever the commodity is held at temperatures favorable to rot development, protection against attendant losses can best be obtained from effective and acceptable chemicals applied at time of packing. Although diphenyl is more effective against citrus stem-end rot than against green mold, it is unique in that it greatly retards the development and release of the green powdery spores which, when not confined by individual fruit wraps, tend to scatter through the package and soil nearby fruit. On the other hand, the sodium orthophenylphenate-hexamine treatment is more effective against green mold than stem-end rot. The double treatment, sodium orthophenylphenate-hexamine applied to fruit and diphenyl to fruit wraps or cartons or liners, is more effective than either used alone. Ethyl thionocarbamate, a new compound in the field of fruit protection, is much more effective against orange rots than sodium orthophenylphenate-hexamine and diphenyl. It is still in the experimental stage and the effect of residues on or in the fruit on consumers is not known.

Both the sea and air temperatures in the test shipments from Florida were above 50° F. most of the time and even above 60° for the first 4 to 8 days. Hence, sound delivery and a reasonable shelf-life expectancy should not be expected when citrus is shipped without refrigeration from Florida to Europe.

Holding tests in Florida indicate that none of the decay inhibitors in common use can be substituted successfully for refrigeration at a desirable temperature, when transit periods are long, temperatures well above 50°, and the fruit is fully ripe.

APPENDIX

Tables 1-9 show temperatures of fruit during loading and in different positions in the hold and temperatures of air circulated through the holds during transit.

Tables 10-18 show condition of test lots at unloading in Europe and after holding in storage for several weeks.

Tables 19-23 show condition of oranges and grapefruit in simulated shipping tests at Orlando.

TABLE 1. --Temperatures ($^{\circ}$F.) in shipment of citrus fruit from Florida packinghouses to Rotterdam in ventilated and refrigerated chambers of Ship A, March 18 to April 5, 1955[1]

Position in ship	March														April				
	18	19	20	21	22	23	24	25	26[2]	27	28	29	30	31	1	2	3	4	5
Deck B, hold No. 2, ventilated:																			
Temperature of fruit (test lots 1, 3, 5, 6, 9, 10, 11):[3]																			
Top layer	)							(58	54	53	53	54	54	55	56	56	57	57	--
Middle layer	(81	77	68	67	65	56	53	)53	54	54	56	57	57	58	59	60	61	62	--
Bottom layer	)							(52	53	53	54	55	55	56	57	57	57	58	--
Temperature of air in hold:																			
Delivered air									45	52	48	47	50	55	55	52	54	51	50
Discharged air									55	55	56	55	56	56	56	58	60	59	59
Deck A, hold No. 3, refrigerated:																			
Temperature of fruit (lots 2, 4, 7, 8):[3]																			
Top layer	)						(51	49	43	42	40	39	39	38	38	38	38	37	37
Middle layer	(81	73	61	58	51	49	)52	52	48	45	43	41	40	39	39	39	39	38	37
Bottom layer	)						(50	48	42	41	39	39	39	38	39	39	39	37	37
Temperature of air in hold:																			
Delivered air									34	34	34	35	35	35	36	36	33	33	33
Discharged air									41	40	38	38	38	37	38	38	37	36	37
Deck A, hold No. 4, ventilated:																			
Temperature of fruit (no test lots):[3]																			
Top layer							59	56	54	54	51	52	51	53	55	55	57	57	56
Middle layer							57	57	56	56	56	56	55	56	56	57	58	58	58
Bottom layer							56	55	53	53	51	52	53	53	54	55	56	56	56
Temperature of air in hold:																			
Delivered air									48	47	54	46	53	53	52	58	55	48	--
Discharged air									67	64	69	70	69	69	71	69	71	72	70

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[1] Florida oranges and grapefruit (not precooled) were shipped to New York City in trucks. Temperatures of fruit ($^{\circ}$F.):

	Refrigerated holds		Ventilated holds	
	Range	Average	Range	Average
During ship loading	45 - 57	51.0	49 - 90	55.8
During ship unloading	38 - 44	40.7	54 - 63	58.8

Ship A was loaded in New York City and sailed March 26, 1955; arrived in Rotterdam April 5, 1955.

During the voyage, air temperature ranged from 38° to 58° F. and averaged 48.9°; sea temperature ranged from 36° to 63° and averaged 51.2°. Temperatures in table were as of noon before loading on ship; after loading 7 to 8 a.m.

Shipment consisted of 4/5-bushel ventilated telescope cartons equivalent to 19,402 1 3/5-bushel crates.

Lots 5, 6, 9, 10, and 11 were packed March 18, lots 1 and 3 were packed March 19; loaded on ship March 25.

Lots 7 and 8 were packed March 18, lots 2 and 4 were packed March 19; loaded March 24.

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

TABLE 2.--Temperatures (°F.) in shipment of citrus fruit from Florida packinghouses to Europe in refrigerated chambers of Ship D, November 15 to December 8, 1954[1]

Position in ship	November																December							
	15	16	17	18	19	20	21	22	23[2]	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8
Deck B, hold No. 2:																								
Temperature of fruit (test lots 13, 15, 21):[3]																								
Top layer	)							(48	46	44	43	41	41	40	39	39	39	39	39	39	39	39		
Middle layer	(83	79	58	48	44	44	45	)47	47	45	45	44	43	43	43	42	42	42	41	41	41	41		
Bottom layer	)							(46	44	42	41	39	39	38	38	38	38	38	38	38	38	37		
Temperature of air in hold:																								
Delivered air									44	40	41	40	39	39	38	38	38	38	38	38	38	38		
Discharged air									46	42	42	40	39	39	38	38	38	39	39	38	38	38		
Deck C, hold No. 2:																								
Temperature of fruit (no test lots):[3]																								
Top layer							48	45	45	44	41	41	41	41	40	40	40	39	39	39	39	39		
Middle layer							50	49	47	47	45	45	44	44	43	43	43	42	41	42	42	41		
Bottom layer							48	44	43	43	40	40	40	39	39	39	39	39	38	39	39	38		
Temperature of air in hold:																								
Delivered air									42	40	38	38	38	38	38	38	38	38	38	38	38	38		
Discharged air									47	46	43	43	42	42	41	41	41	40	39	40	40	40		
Deck D, hold No. 2:																								
Temperature of fruit (test lots 12, 14, 16, 17, 18, 19, 20):[3]																								
Top layer	)					(56	52	46	46	44	43	41	41	40	39	39	39	39	39	39	39	39	39	39
Middle layer	(84	79	61	58	51	)57	54	49	48	47	46	44	43	42	41	41	41	41	40	40	40	40	41	40
Bottom layer	)					(56	53	48	47	45	45	43	43	42	41	41	41	41	40	40	40	40	41	40
Temperature of air in hold:																								
Delivered air									43	40	40	38	39	39	38	39	38	39	39	38	38	38	38	38
Discharged air									45	45	44	42	42	41	41	41	40	40	40	40	40	40	40	39

[1] Florida oranges and grapefruit were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	48 - 60	52.6
During ship unloading	34 - 38	* 35.4

* There was no test fruit on this deck (3-B). The ship's captain had instructions to reduce the temperature in this deck to 32° F., and in all other decks the temperature was maintained at 38°.

Ship D was loaded at Ft. Pierce, Fla., and sailed Nov. 23, 1954; arrived Antwerp Dec. 5; in Rotterdam Dec. 7; and in Hamburg Dec. 10, 1955.

During the voyage, air temperature ranged from 34° to 76° F. and averaged 53.9°; sea temperature ranged from 48° to 82° and averaged 61.6°. Temperatures in table were as of noon before loading on ship; after loading, 9 a.m.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 61,090 1 3/5-bu. crates.

Position in ship and lot number	Date packed	Days pre-cooled	Date loaded on ship	Type of package
Deck B, hold No. 2:				
Lots 13, 15	11 - 15	5	11 - 22	Cartons
Lot 21	11 - 16	5	11 - 22	Cartons
Deck D, hold No. 2:				
Lots 12, 14	11 - 15	2	11 - 19	Crates
Lot 20	11 - 16	2	11 - 19	Crates
Lots 16, 17, 18	11 - 17	2	11 - 19	Crates
Lot 19	11 - 17	2	11 - 19	Cartons

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

TABLE 3.--Temperatures (°F.) in shipments of citrus fruit from Florida packinghouses to Rotterdam in refrigerated chambers of Ship E, April 7 to 30, 1955[1]

Position in ship	April																								May	
	7	8	9	10	11	12	13	14	15	16	17	18	19[2]	20	21	22	23	24	25	26	27	28	29	30	1	2
Deck D, hold No. 2:																										
Temperature of fruit (test lots 92, 94, 95, 100, 101, 102):[3]																										
Top layer	)							(41	43	42	40	39	39	38	38	38	38	38	38	38	38	37	37	36	36	36
Middle layer	(74	68	55	47	42	40	40	)39	41	42	42	42	41	41	41	41	40	40	39	39	39	39	38	38	Slow	
Bottom layer	)							(39	40	39	37	35	34	35	35	35	35	35	34	34	35	34	34	34	33	33
Temperature of air in hold:																										
Delivered air													30	31	32	31	31	31	31	32	32	33	33	33	33	33
Discharged air													34	34	34	34	33	33	33		Thermograph failed					
Deck A, hold No. 4:																										
Temperature of fruit (test lots 93, 96, 97, 98, 99, 105, 106):[3]																										
Top layer	)								(45	45	41	43	37	34	34	33	33	33	33	33	33	33	33	33	33	
Middle layer	(76	72	55	47	44	42	41	45	)43	45	41	39	41	41	40	39	38	38	37	36	36	35	35	34	34	
Bottom layer	)								(46	45	41	41	38	37	37	36	35	35	35	35	35	34	33	33	33	
Temperature of air in hold:																										
Delivered air													37	35	34	34	32	31	31	31	30	30	30	29	29	
Discharged air													38	36	37	36	36	36	36	36	35	35	35	35	--	
Deck A, hold No. 4:																										
Temperature of fruit (test lots 103, 104):[3]																										
Top layer	)											(38	37	34	34	34	33	33	33	33	32	32	32	32	31	
Middle layer	(							71	61	49	42	)41	41	37	35	34	33	33	32	32	32	32	32	31	31	
Bottom layer	)											(41	38	35	34	34	33	33	33	33	33	31	31	31	31	
Temperature of air in hold:																										
Delivered air													37	35	34	34	32	31	31	31	30	30	30	29	29	
Discharged air													38	36	37	36	36	36	36	36	35	35	35	35	--	

[1] Florida oranges and grapefruit were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	38 - 60	46.5
During ship unloading	33 - 42	36.0

Ship E was loaded at Ft. Pierce, Fla., and sailed April 19, 1955; arrived in Rotterdam April 30, 1955.

During the voyage, air temperature ranged from 47° to 72° F. and averaged 58.4°; sea temperature was not available. Temperatures in table were as of noon.

Shipment consisted of 4/5-bu. telescope cartons and 4/5-bu. (1/2 Bruce) wirebound crates, mostly cartons, equivalent to 46,963 1 3/5-bu. crates.

Position in ship and lot number	Date packed	Days pre-cooled	Date loaded on ship	Type of package
Deck D, hold No. 2:				
Lots 100, 101, 102	4 - 5	6	4 - 14	Cartons
Lot 94	4 - 7	6	4 - 14	Cartons
Lots 92, 95	4 - 8	6	4 - 14	Cartons
Deck A, hold No. 4:				
Lots 93, 96, 97	4 - 7	6	4 - 15	Cartons
Lots 105, 106	4 - 7	6	4 - 15	Cartons
Lots 98, 99	4 - 12	3	4 - 15	Cartons
Lots 103, 104	4 - 14	4	4 - 18	Crates

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

TABLE 4.--Temperatures (°F.) in shipment of oranges from Florida packinghouses to Europe in refrigerated chambers of Ship B, January 14 to February 10, 1955[1]

Position in ship	January																		February								
	14	15	16	17	18	19	20	21	22	23	24	25	26[2]	27	28	29	30	31	1	2	3	4	5	6	7	8	9
Deck B, hold No. 2																											
Temperature of fruit (test lots 24, 25, 26, 30, 31):[3]																											
Top layer	)												(38	39	39	38	38	38	38	38	37	37	36		Thermographs failed		
Middle layer	(61	58	47	43	41	41	41	40	39	39	39	39)	39	41	40	40	41	41	41	41	41	41			Do		
Bottom layer	)												(39	40	39	38	39	39	38	38					Do		
Temperature of air in hold:																											
Delivered air													42	40	38	38	38	38	38	38	38	38	38	38	38	36	
Discharged air													43	40	39	38	39	39	39	38	38	38	38	38	38	39	
Deck A, hold No. 4																											
Temperature of fruit (test lots 22, 23, 27, 28, 29):[3]																											
Top layer	)												(44	41	41	41	41	41	41	40	40	40	39	39	39	39	41
Middle layer	(				79	73	58	53	50	47	45	44)	42	42	42	42	42	42	42	42	42	42	41	41	41	41	40
Bottom layer	)												(44	42	40	40	40	40	40	40	40	40	40	40	40	40	41
Temperature of air in hold:																											
Delivered air[4]													37	39	36	37	38	37	36	37	37	37	38	37	36	36	
Discharged air													42	42	40	40	41	40	40	40	40	40	40	40	40	40	

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[1] Florida oranges were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	37 - 50	41.1
During ship unloading	38 - 49	40.7

Ship B was loaded at Jacksonville, Fla., and sailed Jan. 26, 1955; arrived in Antwerp Feb. 9; in Rotterdam Feb. 10, 1955.

During the voyage, air temperature ranged from 52° to 64° F. and averaged 56.5°; sea temperature ranged from 52° to 73° and averaged 63.1°. Temperatures in table were as of noon.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 50,000 1 3/5-bu. crates.

Fruit on deck B, hold No. 2 was packed Jan. 14, precooled 11 days, and loaded Jan. 26. Fruit on deck A, hold No. 4 was packed Jan. 18, precooled 6 days, and loaded Jan. 26. All test fruit was packed in cartons.

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

[4] Ship's air-thermometer readings (thermograph in this location failed).

TABLE 5.--Temperatures (°F.) in shipment of oranges from Florida packinghouses to Europe in refrigerated chambers of Ship C, January 28 to February 22, 1955[1]

Position in ship	January				February																				
	28	29	30	31	1	2	3	4[2]	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Deck B, hold No. 2:																									
Temperature of fruit (test lots 32, 33, 34, 37, 40):[3]																									
Top layer								42	44	41	40	39	38	38	38	38	39	39	39	39	38	38	38	38	
Middle layer	63	61	49	43	41	39	39	41	44	44	42	41	40	40	40	40	41	41	41	41	41	41	41	41	
Bottom layer								41	45	43	39	38	38	38	37	37	37	38	38	38	37	37	37	37	
Temperature of air in hold:																									
Delivered air								47	40	37	36	36	36	36	36	36	36	36	37	37	34	32	33	33	
Discharged air								47	43	37	37	38	37	37	37	38	38	38	37	37	34	34	36	36	
Deck D, hold No. 2:																									
Temperature of fruit (test lots 35, 36, 38, 39, 41):[3]																									
Top layer						37	41	43	43	41	40	40	39	39	39	39	39	39	39	40	40	40	40	41	41
Middle layer	66	65	47	41	39	37	38	39	40	41	42	43	44	44	45	46	46	45	45	45	45	46	46	45	44
Bottom layer						37	41	42	43	43	43	43	43	43	42	43	43	43	45	44	44	45	45	43	42
Temperature of air in hold:																									
Delivered air								40	39	37	35	35	35	35	35	35	35	35	35	37	35	35	36	35	36
Discharged air								42	42	38	36	38	36	36	36	37	37	37	36	38	35	37	38	37	--

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[1] Florida oranges were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	36 - 61	44.3
During ship unloading	34 - 48	38.4

Ship C was loaded at Jacksonville, Fla., and sailed Feb. 4, 1955; arrived in Antwerp Feb. 19; in Rotterdam Feb. 22, 1955.

During the voyage, air temperature ranged from 30° to 60° F. and averaged 49.4°; sea temperatures were not available. Temperatures in the table were as of noon.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 50,000 1 3/5-bu. crates.

Fruit on deck B, hold No. 2 was packed Jan. 28, precooled 6 days, and loaded Feb. 4. Fruit on deck D, hold No. 2 was packed Jan. 28, precooled 4 days, and loaded Feb. 2. All test fruit was packed in cartons.

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

TABLE 6.--Temperatures (°F.) in shipment of oranges from Florida packinghouses to Europe in refrigerated chambers of Ship B, March 8 to 30, 1955[1]

Position in ship	March																					
	8	9	10	11	12	13	14[2]	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Deck D, hold No. 1:																						
Temperature of fruit (test lots 44, 45, 48, 49, 51, 52):[3]																						
Top layer	)				(44	50	50	49	47	46	43	43	41	41	40	40	39	38	37	37	37	37
Middle layer	(67	70	58	47	)41	43	44	46	47	48	48	48	48	47	47	47	47	46	46	45	45	45
Bottom layer	)				(40	43	45	46	46	46	45	44	44	43	42	42	41	41	40	38	38	38
Temperature of air in hold:																						
Delivered air							47	44	42	41	40	38	38	38	37	35	35	35	35	34	32	36
Discharged air							49	45	43	43	41	40	39	39	38	37	38	36	35	34	35	37
Deck A, hold No. 2:																						
Temperature of fruit (test lots 42, 43, 46, 47, 50, 53, 54):[3]																						
Top layer	)					(38	48	46	43	42	41	40	40	39	39	38	38	38	38	37	37	
Middle layer	(70	64	47	41	39	)39	43	45	44	43	42	41	39	38	38	37	37	38	37	36	36	
Bottom layer	)					(40	46	46	45	45	44	43	42	41	41	40	40	40	38	38	37	
Temperature of air in hold:																						
Delivered air							45	43	40	38	37	35	35	34	33	33	37	32	32	32	34	
Discharged air							56	50	51	47	46	45	44	44	44	41	47	44	44	43	45	

[1] Florida oranges were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	38 - 74	53.7
During ship unloading	36 - 55	39.4

Ship B was loaded at Jacksonville, Fla., and sailed March 14; arrived in Antwerp March 28; in Rotterdam March 30, 1955.

During the voyage, air temperature ranged from 34° to 86° F. and averaged 54.6°; sea temperature ranged from 50° to 75° F. and averaged 64.5°. Temperatures in table were as of noon.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 50,000 1 3/5-bu. crates.

Position in ship and lot number	Date packed	Days pre-cooled	Date loaded on ship	Type of package
Deck D, hold No. 1:				
Lot 45	3 - 7	3	3 - 12	Cartons
Lots 44, 48, 49, 51, 52	3 - 8	3	3 - 12	Cartons
Deck A, hold No. 2:				
Lot 50	3 - 7	4	3 - 13	Cartons
Lots 42, 43, 46, 47, 53, 54	3 - 8	4	3 - 13	Cartons

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

TABLE 7. --Temperatures (°F.) in shipment of oranges and grapefruit from Florida packinghouses to Europe in refrigerated chambers of Ship B, April 8, to May 3, 1955[1]

Position in ship	April																							May
	8	9	10	11	12	13	14	15	16	17	18	19[2]	20	21	22	23	24	25	26	27	28	29	30	1
Deck A, hold No. 1:																								
Temperature of fruit (test lots 56, 59, 60, 62, 65):[3]																								
Top layer	)											(43	43	42	41	41	40	40	39	37	37	39	39	37
Middle layer	(79	73	57	48	44	41	40	39	37	37	37	)37	37	36	36	35	35	35	35	35	35	35	36	36
Bottom layer	)											(37	38	38	38	37	37	36	35	33	33	33	33	33
Temperature of air in hold:																								
Delivered air												58	42	40	39	39	36	36	35	36	36	36	34	34
Discharged air												59	43	41	40	39	38	38	37	38	37	37	36	35
Deck B, hold No. 1:																								
Temperature of fruit (test lot 66):[3]																								
Middle layer[4]					63	55	52	51	37	37	35	37	37	37	37	37	35	35	35	34	34	33	33	33
Temperature of air in hold:																								
Delivered air												38	38	36	35	33	34	33	33	33	33	33	33	33
Discharged air												40	38	37	36	35	35	34	33	34	34	33	33	34
Deck B, hold No. 4:																								
Temperature of fruit (test lots 55, 57, 58, 61, 63, 64):[3]																								
Top layer	)										)38	40	41	41	39	39	38	38	38	37	37	37	37	37
Middle layer	(79	76	61	46	42	40	39	38	38	37	)35	39	41	41	42	42	41	41	41	41	41	41	41	40
Bottom layer	)										(38	39	40	40	41	41	40	40	39	38	38	Thermo. failed		
Temperature of air in hold:																								
Delivered air[5]												39	38	37	36	37	35	36	35	34	36	34	34	34
Discharged air												44	43	43	43	42	41	41	41	39	40	39	38	37

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[1] Florida oranges and grapefruit were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	35 - 50	41.6
During ship unloading	39 - 50	41.8

Ship B was loaded at Jacksonville, Fla., and sailed April 19, 1955; arrived in Antwerp May 1; in Rotterdam May 3, 1955.

During the voyage, air temperature ranged from 46° to 70° F. and averaged 62.0°; sea temperature ranged from 57° to 79° F. and averaged 66.5°. Temperatures in the table were as of noon.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 50,000 1 3/5-bu. crates.

Position in ship and lot number	Date packed	Days pre-cooled	Date loaded on ship	Type of package
Deck A, hold No. 1:				
Lots 56, 62	4 - 7	10	4 - 19	Cartons
Lots 59, 60, 65	4 - 8	10	4 - 19	Cartons
Deck B, hold No. 1:				
Lot 66	4 - 12	6	4 - 18	Cartons
Deck B, hold No. 4:				
Lots 55, 58, 61	4 - 8	9	4 - 18	Cartons
Lots 57, 63, 64	4 - 6	9	4 - 18	Cartons

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

[4] Thermographs were placed in middle position only on this deck. This test lot (6 cartons of grapefruit) was nested in the comparatively small commercial consignment of grapefruit to establish approximate transit temperatures of this variety.

[5] Ship's air-thermometer readings. (Thermograph in this location failed.)

TABLE 8.--Temperature (°F.) in shipment of oranges from Florida packinghouses to Europe in refrigerated chambers of Ship C, April 25 to May 13, 1955[1]

Position in ship	April						May												
	25	26	27	28	29[2]	30	1	2	3	4	5	6	7	8	9	10	11	12	13
Deck C, hold No. 1:																			
Temperature of fruit (test lots 67, 72, 73, 74, 75, 76, 77, 78):[3]																			
Top layer	)			(55	53	53	48	47	47	45	43	41	39	39	38	37	37	37	36
Middle layer	(	85	80	)49	50	51	51	51	51	51	49	49	47	47	45	43	42	41	41
Bottom layer	)			(51	49	49	49	48	47	47	46	45	43	42	41	41	39	39	39
Temperature of air in hold:																			
Delivered air					52	47	42	44	44	42	38	36	35	34	35	34	34	34	34
Discharged air					53	53	45	45	44	43	40	37	37	35	37	35	35	35	34
Deck A, hold No. 3:																			
Temperature of fruit (test lots 68, 69, 70, 71):[3]																			
Top layer	)			(41	55	57	57	56	53	49	46	44	44	45	45	45	44	44	44
Middle layer	(79	76	54	)45	49	53	54	56	56	55	55	55	56	56	56	55	55	55	54
Bottom layer	)			(47	51	54	55	55	55	53	52	50	49	49	48	48	48	47	47
Temperature of air in hold:																			
Delivered air					63	58	56	53	45	42	40	42	44	44	44	44	42	43	43
Discharged air					66	60	57	53	49	44	41	42	44	44	45	44	43	44	44

[1] Florida oranges were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	36 - 62	48.1
During ship unloading	36 - 50	40.3

Ship C was loaded at Jacksonville, Fla., and sailed April 29, 1955; arrived in Antwerp May 12; in Rotterdam May 13, 1955.

During the voyage, air temperature ranged from 50° to 73° F. and averaged 62.2°; sea temperatures were not available. Temperatures in the table were as of noon.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 50,000 1 3/5-bu. crates.

Position in ship and lot number	Date packed	Days pre-cooled	Date loaded on ship	Type of package
Deck C, hold No. 1:				
Lot 67	4 - 26	1	4 - 28	Cartons
Lots 72, 73, 74, 75, 76, 77, 78	4 - 25*	1	4 - 28	Cartons
Deck A, hold No. 3:				
Lots 68, 70	4 - 25	2	4 - 28	Cartons
Lots 69, 71	4 - 26	2	4 - 28	Cartons

* Thermographs were placed in test fruit cartons on day after packing.

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

TABLE 9. --Temperatures (°F.) in shipment of oranges from Florida packinghouses to Europe in refrigerated chambers of Ship B, May 12 to June 3, 1955[1]

Position in ship	May																				June	
	12	13	14	15	16	17	18	19	20[2]	21	22	23	24	25	26	27	28	29	30	31	1	2
Deck B, hold No. 2:																						
Temperature of fruit (test lot 79):[3]																						
Top layer	)				Thermograph failed																	
Middle layer	(				73	58	45	42	)43	52	51	50	48	47	45	44	42	43	41	40	38	38
Bottom layer	)								(42	52	53	52	50	50	49	46	45	44	43	42	40	39
Temperature of air in hold:																						
Delivered air[4]									55	54	41	38	39	41	41	39	38	38	36	34	35	34
Discharged air									58	54	51	49	45	42	42	40	40	38	36	35	36	37
Deck C, hold No. 2:																						
Temperature of fruit (test lots 81, 85, 86, 87, 88, 89, 90, 91):[3]																						
Top layer	)							(42	51	52	49	47	46	46	44	41	40	39	39	38	37	37
Middle layer	(81	80	60	50	45	42	41	)42	51	53	53	52	51	50	48	47	45	45	44	43	41	41
Bottom layer	)							(37	47	51	50	49	47	47	45	43	41	41	41	39	37	37
Temperature of air in hold:																						
Delivered air									52	50	45	42	42	42	39	37	36	37	35	34	33	34
Discharged air[4]									61	51	46	45	42	42	43	40	40	40	40	38	36	37
Deck B, hold No. 3:																						
Temperature of fruit (test lots 80, 82, 83, 84):[3]																						
Top layer	)						(38	44	47	52	51	48	45	43	41	39	38	38	38	37	37	38
Middle layer	(87	82	53	45	42	39	)38	45	47	51	52	52	50	49	48	47	44	43	43	41	41	41
Bottom layer	)						(41	45	47	51	51	51	50	49	47	45	43	43	42	41	40	40
Temperature of air in hold:																						
Delivered air									50	49	50	45	42	40	41	36	37	36	35	35	35	40
Discharged air									52	54	51	49	46	45	45	43	42	39	41	39	39	41

[1] Florida oranges were shipped to Florida ports in trucks and placed in shipside precooling rooms until loading time. Temperature of fruit (°F.):

	Range	Average
During ship loading	36 - 74	48.9
During ship unloading	36 - 59	42.4

Ship B was loaded at Jacksonville, Fla., and sailed May 20, 1955; arrived in Antwerp June 2; in Rotterdam June 3, 1955.

During the voyage, air temperature ranged from 48° to 82° F. and averaged 65.5°; sea temperature ranged from 52° to 84° F. and averaged 66°. Temperatures in the table were as of noon.

Shipment consisted of 1 3/5-bu. standard nailed boxes and 4/5-bu. ventilated telescope cartons, mostly cartons, equivalent to 50,000 1 3/5-bu. crates.

Position in ship and lot number	Date packed	Days pre-cooled	Date loaded on ship	Type of package
Deck B, hold No. 2:				
Lot 79	5 - 16	4	5 - 20	Cartons
Deck C, hold No. 2:				
Lots 81, 85, 86, 87, 88, 89, 90, 91	5 - 12	6	5 - 19	Cartons
Deck B, hold No. 3:				
Lots 80, 82, 83, 84	5 - 12	5	5 - 18	Cartons

[2] Date of sailing.

[3] A systematic arrangement (by layers) of packages containing thermographs was not followed until fruit was loaded on ship.

[4] Ship's air-thermometer readings. (Thermograph in this location failed.)

TABLE 10.--Development of rind breakdown and decay in non-precooled Florida citrus in overseas shipping tests to Rotterdam - Ship A - sailed March 26, 1955; unloaded April 5-7, 1955

Variety and treatment	Lot number[1]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 1 week in storage							Third inspection after 2 weeks in storage						
				Rind breakdown[2]				Decay[3]			Rind breakdown[2]				Decay[3]			Rind breakdown[2]				Decay[3]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Valencia oranges in diphenyl-treated cartons:																								
Color-added:							*Percent*							*Percent*							*Percent*			
Ventilated hold	3	2-B	745	7	8	1	(*)	10	8	2	11	10	1	(*)	14	12	2	9	10	2	(*)	18	15	3
Refrigerated hold	4	3-A	738	7	6	1	(*)	2	0	2	9	9	2	4	5	1	3	7	10	3	1	10	6	4
Natural color:																								
Ventilated hold	1	2-B	754	3	3	(*)	0	5	1	4	6	4	1	0	6	1	5	5	5	1	0	9	3	6
Refrigerated hold	2	3-A	756	3	3	(*)	0	3	(*)	3	5	4	(*)	0	5	(*)	5	5	6	1	0	7	2	5
Ventilated hold:																								
No antiseptic bath	9	2-B	664	0	0	0	0	9	3	6	0	0	0	0	13	6	7	(*)	1	0	0	17	8	9
Sodium orthophenylphenate-hexamine bath	10	2-B	662	(*)	1	0	0	1	1	1	1	1	0	0	3	1	1	1	1	0	0	5	3	2
Ethyl thionocarbamate bath	11	2-B	663	0	(*)	0	0	(*)	0	(*)	(*)	(*)	0	0	(*)	0	(*)	(*)	1	0	0	(*)	0	(*)
Pink grapefruit in diphenyl-treated cartons:																								
Ventilated hold	5 & 6	2-B	500	1	1	0	0	1	(*)	1	1	1	0	0	2	1	1	1	1	(*)	0	3	1	1
Refrigerated hold	7 & 8	3-A	505	2	3	(*)	0	2	(*)	2	4	4	1	(*)	3	(*)	2	5	6	2	1	3	(*)	3

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[1] Lots 1 and 2; 3 and 4; 5 and 7; and 6 and 8 were comparable samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both. Lots 9, 10, and 11 were comparable but not commercially graded.

[2] Rind breakdown designations:

Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[3] Decay designations:

TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 11.--Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship D[1] - sailed November 23, 1954, unloaded December 7-9, 1954

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 1 week in storage							Third inspection after 2 weeks in storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled citrus							*Percent*							*Percent*							*Percent*			
Color-added Hamlin oranges:																								
Diphenyl-treated wraps in nailed boxes	12	2-D	849	1	(*)	0	0	(*)	(*)	(*)	1	(*)	(*)	0	1	(*)	(*)	4	2	(*)	0	1	1	1
Diphenyl-treated cartons	13	2-B	850	2	1	(*)	0	1	0	1	3	2	1	(*)	1	1	1	7	4	1	(*)	4	3	1
Naked pack in boxes (no diphenyl)	16	2-D	523	3	1	0	0	1	0	1	3	2	(*)	0	1	0	1	5	3	(*)	0	2	1	1
Diphenyl-treated wraps in nailed boxes	17	2-D	528	1	1	0	0	(*)	0	(*)	2	1	(*)	0	(*)	0	(*)	4	2	(*)	0	(*)	0	(*)
Sodium orthophenylphenate-hexamine bath and:																								
Diphenyl-treated wraps in nailed boxes	18	2-D	526	1	0	0	0	(*)	0	(*)	1	(*)	0	(*)	(*)	0	(*)	3	1	(*)	0	(*)	0	(*)
Diphenyl-treated cartons	19	2-B	643	2	0	0	0	0	0	0	3	1	(*)	0	(*)	(*)	0	5	2	0	0	1	1	0
Marsh grapefruit:																								
Diphenyl-treated wraps in nailed boxes	14	2-D	286	24	7	2	(*)	1	0	1	21	13	6	2	1	0	1	23	14	7	3	1	0	1
Diphenyl-treated cartons	15	2-B	378	12	13	6	2	(*)	0	(*)	12	19	14	5	(*)	0	(*)	20	20	16	7	1	(*)	1
Duncan grapefruit:																								
Sodium orthophenylphenate-hexamine bath and:																								
Diphenyl-treated wraps in nailed boxes	20	2-D	202	12	9	7	3	(*)	0	0	13	11	13	14	(*)	0	0	21	19	15	15	(*)	0	0
Diphenyl-treated cartons	21	2-B	220	10	18	11	6	0	0	0	11	25	21	12	0	0	0	13	19	20	24	(*)	(*)	0

[1] All holds refrigerated.

[2] Lots 16, 17, 18 and 19; and 20 and 21 were comparable lots of fruit but not commercially graded. All other lots were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both. Lots 12 and 13; and 14 and 15 were comparable.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - Severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 12. --Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship B[1] - sailed January 26, 1955, unloaded February 10-12, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 1 week in storage							Third inspection after 2 weeks in storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled citrus in diphenyl-treated cartons																								
Pineapple oranges:																								
Color-added:						Percent							Percent							Percent				
No antiseptic bath	24	2-B	1,460	21	16	2	0	1	(*)	1	27	25	3	(*)	2	(*)	2	25	28	5	1	2	(*)	2
Sodium orthophenylphenate-hexamine bath	25	2-B	753	15	6	1	(*)	0	0	0	15	10	2	(*)	0	0	0	14	13	3	(*)	0	0	0
Natural color:																								
No antiseptic bath	22	4-A	1,460	8	6	2	1	3	(*)	2	10	14	3	1	3	(*)	2	10	15	4	1	3	(*)	2
Sodium orthophenylphenate-hexamine bath	23	4-A	755	14	15	3	2	(*)	(*)	0	15	35	6	3	(*)	(*)	(*)	15	35	9	4	(*)	(*)	(*)
Temple oranges - natural color:																								
No antiseptic bath	26	2-B	642	9	5	0	0	8	0	8	15	5	(*)	0	10	0	10	14	8	(*)	0	12	0	12
Sodium orthophenylphenate-hexamine bath	27	4-A	600	4	10	3	1	5	0	5	17	26	10	4	6	(*)	5	15	27	12	5	7	(*)	6
Marsh grapefruit	28	4-A	312	12	9	5	2	1	0	1	14	13	6	6	1	0	1	14	14	6	8	1	0	1
Duncan grapefruit	29	4-A	248	6	8	2	(*)	1	(*)	1	17	20	9	3	1	(*)	1	18	21	10	4	1	(*)	1
Marsh grapefruit	30	2-B	287	19	13	8	18	1	0	1	15	19	11	19	2	(*)	1	14	19	11	23	2	(*)	1
Duncan grapefruit	31	2-B	285	12	19	15	20	0	0	0	12	17	19	24	0	0	0	9	16	20	31	0	0	0

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[1] All holds refrigerated.

[2] All lots were from different points of origin or packinghouses. All lots were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 13. --Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship C[1] - sailed February 4, 1955, unloaded February 22-24, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 1 week in storage							Third inspection after 2 weeks in storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled, natural color citrus in diphenyl-treated cartons																								
Temple oranges:						Percent							Percent							Percent				
No antiseptic bath	40	2-B	594	3	3	1	0	11	0	11	3	5	1	0	14	0	14	5	6	2	0	18	0	17
Sodium orthophenylphenate-hexamine bath	41	2-D	609	7	9	1	0	(*)	0	(*)	9	9	2	0	(*)	0	(*)	11	11	3	0	1	0	(*)
Pineapple oranges:																								
No antiseptic bath	32	2-B	1,481	8	8	(*)	0	1	0	1	7	9	1	0	1	0	1	9	11	1	0	1	0	1
Do.	35	2-D	1,457	13	15	(*)	(*)	2	(*)	2	12	16	1	(*)	3	(*)	2	13	17	2	(*)	3	(*)	2
Sodium orthophenylphenate-hexamine bath	36	2-D	652	13	11	0	0	(*)	0	(*)	15	14	(*)	0	(*)	0	(*)	17	17	2	(*)	(*)	0	(*)
No antiseptic bath	33	2-B	699	9	9	3	1	1	0	1	8	13	4	1	1	0	1	12	15	5	1	1	0	1
Sodium orthophenylphenate-hexamine bath	34	2-B	711	13	9	3	1	0	0	0	9	15	3	1	0	0	0	14	17	3	2	0	0	0
Marsh grapefruit:	37	2-B	288	9	18	20	36	0	0	0	10	17	24	40	0	0	0	8	17	21	44	0	0	0
Do.	38	2-D	286	17	21	9	13	1	0	1	19	19	11	15	1	0	1	20	21	11	16	1	0	1
Ruby Red grapefruit:	39	2-D	270	7	13	6	1	1	0	1	8	15	7	3	1	0	1	10	13	9	5	1	0	1

[1] All holds refrigerated.

[2] Lots 33 and 34 were comparable lots of fruit; all other lots were from different points of origin and different packinghouses. All lots except 33 and 34 were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 14. --Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship B[1] - sailed March 14, 1955, unloaded March 30-April 1, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 1 week in storage							Third inspection after 2 weeks in storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled citrus in diphenyl-treated cartons																								
Valencia oranges:							*Percent*							*Percent*							*Percent*			
Color-added fruit	42	2-A	607	3	13	1	(*)	1	0	(*)	5	13	1	1	3	(*)	2	10	15	3	4	7	4	3
Do	43	2-A	626	2	3	0	(*)	(*)	0	(*)	2	4	0	(*)	2	0	2	4	5	0	(*)	4	1	3
Do	44	1-D	645	9	11	1	(*)	(*)	0	(*)	11	16	3	1	(*)	0	(*)	15	17	4	1	3	1	2
Natural color fruit:																								
Sodium orthophenylphenate-hexamine bath	45	1-D	621	3	3	(*)	(*)	1	0	(*)	4	4	(*)	(*)	1	0	1	5	5	1	(*)	2	(*)	2
No antiseptic bath	46	2-A	371	0	(*)	0	0	(*)	0	(*)	1	3	(*)	0	3	0	3	3	5	1	0	7	1	5
Ethyl thionocarbamate bath	47	2-A	377	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	2	(*)	0	0	0	0
Pineapple oranges, natural color:																								
No antiseptic bath	48	1-D	595	6	12	3	1	1	(*)	1	7	18	5	2	7	2	4	8	19	7	3	19	6	13
Sodium orthophenylphenate-hexamine bath	49	1-D	582	5	12	4	2	0	0	0	10	17	6	5	1	0	1	13	22	8	6	5	2	4
Temple oranges, natural color	50	2-A	569	2	3	1	0	11	0	10	3	4	1	0	23	(*)	21	2	2	1	0	34	(*)	33
Grapefruit:																								
Marsh	51	1-D	252	1	2	(*)	0	(*)	0	(*)	6	5	1	0	2	1	1	7	6	1	0	3	2	1
Duncan	52	1-D	227	2	2	(*)	0	(*)	0	(*)	3	3	(*)	0	1	(*)	(*)	4	4	(*)	0	2	(*)	1
Marsh:																								
No antiseptic treatment	53	2-A	240	3	4	1	(*)	(*)	(*)	0	4	5	1	3	(*)	(*)	0	9	7	1	3	3	(*)	(*)
Sodium orthophenylphenate-hexamine bath	54	2-A	224	4	2	2	4	0	0	0	8	5	1	3	(*)	(*)	0	9	9	2	3	3	1	0

---

[1] All holds refrigerated.

[2] Lots 46 and 47; 48 and 49; 53 and 54 were comparable lots of fruit. All other lots were from different points of origin and different packinghouses. Lots 42, 43, 44, 45, 50, 51, and 52 were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 15. --Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship E[1] - sailed April 19, 1955, unloaded May 2-4, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 2 weeks in refrigerated storage							Third inspection after 1 week in common storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled citrus																								
Valencia oranges in wirebound crates:																								
Color-added fruit:							Percent							Percent						Percent				
Naked pack - no diphenyl	103	4-A	316	9	7	1	1	(*)	0	(*)	11	21	4	2	4	0	4	11	20	5	2	9	3	5
Diphenyl-treated crate liners	104	4-A	315	5	3	1	0	1	0	1	9	11	2	2	3	0	3	11	12	2	1	4	(*)	4
Valencia oranges in diphenyl-treated cartons:																								
Color-added fruit	92	2-D	638	3	2	(*)	(*)	1	0	1	5	7	1	(*)	5	(*)	4	7	9	1	(*)	6	1	5
Do	93	4-A	630	3	2	0	0	5	1	4	5	8	1	0	9	2	7	6	10	2	(*)	11	3	8
Natural color fruit:																								
No antiseptic bath	94	2-D	633	1	(*)	(*)	0	3	0	3	4	6	1	0	6	(*)	6	4	9	1	0	8	2	6
Do	95	2-D	648	3	2	1	(*)	1	(*)	(*)	5	4	1	(*)	2	1	1	7	7	2	(*)	6	4	2
Do	96	4-A	636	1	(*)	(*)	0	1	0	1	4	4	(*)	(*)	4	(*)	3	4	6	1	(*)	6	1	4
Sodium orthophenylphenate-hexamine bath	97	4-A	746	5	2	(*)	(*)	(*)	(*)	(*)	8	6	(*)	0	3	1	1	8	11	1	(*)	7	5	2
No antiseptic wax	98	4-A	270	0	0	0	0	0	0	0	1	2	(*)	0	(*)	0	(*)	1	2	0	(*)	6	5	1
Sodium orthophenylphenate-hexamine in wax emulsion	99	4-A	270	0	0	0	0	(*)	0	(*)	4	1	0	0	1	0	1	3	2	(*)	0	2	1	1
No antiseptic bath	100	2-D	665	1	1	0	0	5	2	3	4	4	0	0	9	3	5	5	10	1	0	12	5	6
Sodium orthophenylphenate-hexamine bath	101	2-D	648	(*)	0	0	0	1	(*)	1	1	1	0	0	2	(*)	1	4	3	1	0	4	1	2
Ethyl thionocarbamate bath	102	2-D	647	1	1	(*)	0	(*)	(*)	0	3	3	1	0	(*)	(*)	(*)	3	4	1	0	1	(*)	(*)
Marsh grapefruit in diphenyl-treated cartons:																								
No antiseptic bath	105	4-A	214	12	9	4	(*)	1	0	1	23	16	5	1	6	1	5	22	21	6	1	9	1	7
Sodium orthophenylphenate-hexamine bath	106	4-A	222	11	6	2	0	(*)	0	(*)	16	8	2	0	3	(*)	2	15	8	3	0	6	3	3

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[1] All holds refrigerated.

[2] Lots 98 and 99; 100, 101 and 102; 103 and 104; and 105 and 106 were comparable lots. Lots 92, 93, 94, 95, 96, 97, 103, and 104 were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 16.--Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship B[1] - sailed April 19, 1955, unloaded May 3-4, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 2 weeks in refrigerated storage							Third inspection after 1 week in common storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled citrus in diphenyl-treated cartons																								
Valencia oranges:							*Percent*							*Percent*							*Percent*			
Color-added fruit	58	4-B	571	3	4	0	0	2	(*)	1	5	7	0	0	7	3	3	4	6	(*)	(*)	15	9	5
Do	59	1-A	626	1	(*)	(*)	0	1	0	1	3	3	(*)	0	3	0	3	3	3	1	0	8	3	4
Do	60	1-A	643	8	9	4	3	3	(*)	3	8	16	5	4	8	2	6	6	16	7	4	17	9	7
Do	65	1-A	650	6	4	1	(*)	1	(*)	1	9	10	1	1	4	1	4	9	13	3	1	11	6	5
Natural color fruit:																								
No antiseptic bath	55	4-B	585	2	2	(*)	(*)	1	0	1	4	4	(*)	(*)	3	1	2	3	6	1	(*)	7	4	3
Sodium orthophenylphenate-hexamine bath	61	4-B	641	5	3	(*)	(*)	(*)	0	(*)	5	6	1	(*)	7	4	3	5	7	3	1	16	11	5
No antiseptic bath	56	1-A	584	(*)	(*)	0	0	(*)	0	(*)	3	3	(*)	0	10	8	2	3	7	1	0	19	16	3
Sodium orthophenylphenate-hexamine bath	62	1-A	583	0	(*)	0	0	0	0	0	1	2	0	0	1	(*)	(*)	3	5	1	(*)	4	2	1
No antiseptic bath	57	4-B	697	1	1	(*)	(*)	2	0	2	7	10	1	(*)	6	2	4	7	20	2	(*)	11	5	5
Sodium orthophenylphenate-hexamine bath	63	4-B	696	(*)	1	(*)	0	(*)	0	(*)	4	6	1	0	1	(*)	1	5	7	2	0	3	2	1
Ethyl thionocarbamate bath	64	4-B	712	(*)	1	(*)	0	(*)	0	(*)	(*)	1	(*)	0	(*)	0	(*)	(*)	1	(*)	0	(*)	0	(*)
Marsh grapefruit	66	1-B	237	13	21	19	35	2	0	2	11	22	17	39	7	0	7	12	18	20	41	8	0	8

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[1] All holds refrigerated.

[2] Lots 57, 63 and 64; and 56 and 62 were comparable lots of fruit. Lots 55, 58, 59, 60, 61, 65, and 66 were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

* - Indicates less than 1/2 percent.

TABLE 17. --Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship C[1] - sailed April 29, 1955, unloaded May 14-15, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 2 weeks in refrigerated storage							Third inspection after 1 week in common storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled Valencia oranges																								
Diphenyl-treated cartons:							Percent							Percent							Percent			
Color-added fruit	67	1-C	635	6	5	1	(*)	(*)	0	(*)	7	6	1	(*)	4	2	2	6	5	1	0	24	20	4
Do	68	3-A	635	12	11	4	2	7	1	5	11	21	5	2	15	7	8	10	17	5	1	25	14	11
Do	69	3-A	648	12	8	1	(*)	8	6	1	11	15	1	0	24	21	3	8	11	2	(*)	40	36	3
Natural color fruit:																								
No other treatment	70	3-A	632	9	9	4	1	13	2	11	10	13	3	1	20	5	14	9	13	3	(*)	30	10	19
Do	71	3-A	647	2	1	0	0	3	1	1	3	2	(*)	0	7	4	2	3	3	(*)	0	13	9	3
Sodium orthophenylphenate-hexamine in wax emulsion.	77	1-C	440	1	1	0	0	(*)	(*)	0	2	4	(*)	0	(*)	(*)	0	2	7	1	0	14	14	1
Sodium orthophenylphenate-hexamine bath followed by sodium orthophenylphenate-hexamine in wax emulsion	78	1-C	648	2	1	(*)	0	(*)	(*)	(*)	2	5	(*)	0	3	2	(*)	3	7	1	(*)	20	19	(*)
No other treatment	74	1-C	571	2	(*)	0	(*)	3	(*)	3	3	1	(*)	0	13	9	4	2	2	(*)	0	34	29	6
Sodium orthophenylphenate-hexamine bath	75	1-C	801	2	1	(*)	0	(*)	(*)	(*)	3	3	(*)	0	4	4	(*)	2	3	1	(*)	24	23	1
Ethyl thionocarbamate bath	76	1-C	577	2	1	(*)	(*)	1	0	1	2	3	(*)	(*)	1	(*)	1	2	3	1	(*)	2	1	1
Heavy application diphenyl[5]	73	1-C	496	0	1	0	0	1	0	1	2	4	(*)	0	3	1	1	2	5	2	0	10	8	2
Untreated cartons:																								
Natural color fruit	72	1-C	570	1	1	0	0	1	(*)	1	1	1	0	0	17	15	2	(*)	(*)	0	0	45	41	4

[1] All holds refrigerated.

[2] Lots 72 and 73; 74, 75 and 76; and 77 and 78 were comparable lots of fruit. Lots 67, 68, 69, 70 and 71 were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

[5] Inner surface of carton was painted with a saturated solution of diphenyl in ethyl alcohol.

* - Indicates less than 1/2 percent.

TABLE 18. --Development of rind breakdown and decay in Florida citrus in overseas shipping tests to Rotterdam - Ship B[1] - sailed May 20, 1955, unloaded June 2-7, 1955

Variety and treatment	Lot number[2]	Hold and deck	Number of fruit	First inspection on arrival							Second inspection after 1 week in storage							Third inspection after 2 weeks in storage						
				Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]			Rind breakdown[3]				Decay[4]		
				Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen	Tr	Slt	Mod	Sev	TD	SE	Pen
Precooled Valencia oranges																								
Color-added fruit in diphenyl-treated cartons:						Percent							Percent							Percent				
Wax A	79	2-B	528	10	12	2	1	2	1	2	14	13	2	2	6	2	4	17	17	3	3	18	5	6
Do	80	3-B	642	9	10	2	1	2	(*)	1	10	9	3	1	15	11	3	13	10	3	1	25	18	5
Do	81	2-C	630	17	26	8	8	2	2	(*)	17	22	9	6	18	15	3	12	23	10	3	41	31	4
Do	84	3-B	637	5	9	2	2	2	1	1	7	7	2	3	14	11	3	15	10	1	2	40	28	6
Wax B	82	3-B	658	21	31	9	4	4	1	3	18	33	13	9	14	8	6	17	28	9	11	28	14	9
Do	83	3-B	648	18	28	5	2	4	3	1	24	31	8	4	14	10	2	23	21	6	4	30	17	4
Natural color fruit in diphenyl-treated cartons:																								
No antiseptic bath	87	2-C	562	(*)	3	(*)	0	8	7	(*)	(*)	2	(*)	0	27	25	1	(*)	2	(*)	0	33	31	2
Sodium orthophenylphenate-hexamine bath	88	2-C	534	1	2	(*)	(*)	1	1	1	1	2	(*)	(*)	14	12	1	1	4	1	(*)	22	18	2
Ethyl thionocarbamate bath	91	2-C	522	1	(*)	0	0	0	0	0	1	1	0	0	2	2	0	1	1	0	0	5	5	(*)
Sodium orthophenylphenate-hexamine in wax emulsion	89	2-C	551	(*)	3	(*)	(*)	5	4	1	(*)	3	(*)	(*)	14	13	1	2	4	1	(*)	24	21	2
Sodium orthophenylphenate-hexamine bath followed by sodium orthophenylphenate in wax emulsion	90	2-C	529	1	2	(*)	0	2	2	0	1	2	1	0	7	7	(*)	3	5	1	0	13	12	1
Heavy application diphenyl[5]	86	2-C	556	0	1	0	0	9	9	(*)	(*)	1	0	0	20	19	1	2	3	0	0	27	24	2
Natural color fruit in untreated cartons, no antiseptic bath	85	2-C	534	(*)	(*)	0	0	19	18	1	0	1	0	0	37	35	1	1	1	0	0	46	41	4

[1] All holds refrigerated.

[2] Lots 85 and 86; 87, 88, and 89; and 90 and 91 were comparable lots of fruit. Lots 79, 80, 81, 82, 83, and 84 were samples from commercially graded and packed (U.S. No. 1) lots going to overseas or domestic markets, or both.

[3] Rind breakdown designations:
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Slt - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
Mod - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
Sev - severe - aggregate damage greater than the size of a half dollar.

[4] Decay designations:
TD - total of all decays.
SE - stem-end rot.
Pen - Penicillium rot.

[5] Inner surface of carton was painted with a saturated solution of diphenyl in ethyl alcohol.

* - Indicates less than 1/2 percent.

TABLE 19.--Development of decay in early, midseason, and late oranges at various temperatures during and after storage, in simulated shipping tests at Orlando--Seasons 1953-54 and 1954-55

Storage temperature and length of storage	Number of fruit	Percentage of decay[1]											
		At end of storage				Storage and 1 week at 70°				Storage and 2 weeks at 70°			
		TD	SE	Pen	Misc	TD	SE	Pen	Misc	TD	SE	Pen	Misc
		Percent				*Percent*				*Percent*			
38° F.:													
1 week..................	2,620	(*)	(*)	(*)	(*)	5	1	4	(*)	29	20	8	1
2 weeks.................	2,600	(*)	(*)	0	(*)	10	3	6	1	37	26	10	1
3 weeks.................	2,610	(*)	(*)	(*)	(*)	11	5	5	1	37	29	7	1
4 weeks.................	2,624	(*)	(*)	(*)	(*)	15	10	4	1	42	33	7	2
6 weeks.................	2,620	1	(*)	1	(*)	30	21	7	2	53	40	10	3
50° F.:													
1 week..................	2,623	(*)	(*)	(*)	(*)	10	5	4	1	32	23	8	1
2 weeks.................	2,626	1	(*)	1	(*)	23	17	5	1	42	33	7	2
3 weeks.................	2,642	4	2	2	(*)	31	25	5	1	44	37	6	1
4 weeks.................	2,324	13	9	4	(*)	34	28	5	1	45	36	7	2
60° F.:													
1 week..................	2,643	1	(*)	1	(*)	15	9	5	1	34	26	7	1
2 weeks.................	2,656	9	5	4	(*)	31	22	8	1	42	32	9	1

Continuous Storage at		Percentage of decay after															
		1 week				2 weeks				3 weeks				4 weeks			
		TD	SE	Pen	Misc	TD	SE	Pen	Misc	TD	SE	Pen	Misc	TD	SE	Pen	Misc
		Percent				*Percent*				*Percent*				*Percent*			
60° F.:																	
4 weeks.................	2,621					11	6	5	(*)	27	20	6	1	40	30	8	2
70° F.:																	
3 weeks.................	3,903	3	1	2	(*)	17	12	4	1	34	27	6	1				
80° F.:																	
3 weeks.................	2,615	5	4	1	0	30	27	2	1	44	39	3	2				

[1] Key: TD - total decay.
SE - stem-end rot.
Pen - Penicillium decay.
Misc - miscellaneous decay.
* - Indicates less than 1/2 percent.

TABLE 20. --Development of rind breakdown in grapefruit as effected by temperatures during and after storage, 6 pickings, in simulated shipping tests at Orlando, January through May 1955

Variety and storage temperature	Number of fruit	Percentage of rind breakdown[1] after--																			
		3 weeks storage					Storage and 1 week at 38° F.					Storage and 2 weeks at 38° F.					Storage, 2 weeks at 38° and 1 week at 70° F.				
		Trb	Tr	Sl	M	S	Trb	Tr	Sl	M	S	Trb	Tr	Sl	M	S	Trb	Tr	Sl	M	S
Marsh:				Percent					Percent					Percent					Percent		
32° F.	1,416	2	2	(*)	0	0	4	4	(*)	(*)	0	10	9	1	(*)	0	26	21	4	1	(*)
38°	1,416	9	8	1	(*)	0	23	15	5	2	1	45	30	8	4	3	44	27	9	5	3
45°	1,416	10	9	1	(*)	(*)	14	11	2	1	(*)	23	18	3	1	1	27	20	5	1	1
50°	1,416	1	1	0	0	0	2	2	0	0	0	5	4	1	0	0	10	9	1	0	0
Duncan:																					
32° F.	1,440	2	1	1	0	0	3	3	(*)	0	(*)	9	8	1	(*)	(*)	16	12	3	(*)	1
38°	1,440	8	7	1	(*)	(*)	22	16	4	1	1	37	23	9	3	2	25	12	6	5	2
45°	1,405	9	8	1	(*)	(*)	13	10	2	1	(*)	17	12	3	1	1	18	14	3	1	(*)
50°	1,440	6	5	1	(*)	(*)	8	6	2	(*)	(*)	11	8	3	(*)	(*)	12	10	2	(*)	0

[1] Key: Trb - total rind breakdown.
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Sl - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
M - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
S - severe - aggregate damage greater than the size of a half dollar.

* - Indicates less than 1/2 percent.

TABLE 21. --Development of decay in grapefruit as effected by temperatures during and after storage, 6 pickings, in simulated shipping tests at Orlando, January through May 1955

Variety and storage temperature	Number of fruit	Percentage of decay[1] after--															
		3 weeks storage				Storage and 1 week at 38° F.				Storage and 2 weeks at 38° F.				Storage, 2 weeks at 38° and 1 week at 70° F.			
		Td	SE	Pen	Misc	TD	SE	Pen	Misc	TD	SE	Pen	Misc	TD	SE	Pen	Misc
Marsh:			*Percent*				*Percent*				*Percent*				*Percent*		
32° F.	1,416	(*)	0	(*)	(*)	(*)	0	(*)	(*)	1	0	(*)	1	37	2	32	3
38°	1,416	(*)	0	(*)	(*)	(*)	0	(*)	(*)	1	0	(*)	1	37	4	29	4
45°	1,416	1	(*)	1	(*)	2	(*)	1	1	3	1	1	1	34	10	17	7
50°	1,416	5	2	3	(*)	6	2	3	1	7	3	3	1	32	13	16	3
Duncan:																	
32° F.	1,440	(*)	0	0	(*)	(*)	0	(*)	(*)	(*)	0	(*)	(*)	52	(*)	49	3
38°	1,440	(*)	0	0	(*)	1	0	(*)	1	1	0	(*)	1	57	1	52	4
45°	1,405	3	0	2	1	4	0	2	2	4	(*)	2	2	37	3	28	6
50°	1,440	6	(*)	6	(*)	6	(*)	6	(*)	7	(*)	6	1	36	3	30	3

[1] Key: TD - total decay.
SE - stem-end rot.
Pen - Penicillium decay.
Misc. - miscellaneous decay.

* - Indicates less than 1/2 percent.

TABLE 22.--Development of rind breakdown in grapefruit as effected by various combinations of storage temperatures, in simulated shipping tests at Orlando, June 1955

Temperatures and length of storage periods	Percentage of rind breakdown[1] at end of indicated period									
	Marsh variety[2]					Duncan variety[2]				
	Trb	Tr	Sl	M	S	Trb	Tr	Sl	M	S
			Percent					*Percent*		
32° F. for 3 weeks	1	1	(*)	(*)	0	2	2	(*)	(*)	0
32° F. for 3 weeks + 50° for 2 weeks	2	2	(*)	0	0	4	4	(*)	(*)	0
32° F. for 3 weeks + 50° for 2 weeks + 60° for 1 week	1	1	(*)	0	0	5	4	1	0	0
32° F. for 3 weeks + 50° for 2 weeks + 60° for 2 weeks	(*)	(*)	0	0	0	4	4	(*)	0	0
50° F. for 3 weeks	1	1	(*)	0	0	4	4	(*)	0	0
50° F. for 3 weeks + 32° for 2 weeks	3	2	1	0	0	7	5	2	(*)	0
50° F. for 3 weeks + 32° for 2 weeks + 60° for 1 week	1	1	(*)	(*)	0	8	6	2	(*)	0
50° F. for 3 weeks + 32° for 2 weeks + 60° for 2 weeks	1	1	(*)	0	0	4	3	1	(*)	0

[1] Key: Trb - total rind breakdown.
Tr - trace - aggregate damage less than 1/4 inch in diameter - usually of no commercial significance.
Sl - slight - aggregate damage 1/4 inch in diameter to area size of a dime.
M - moderate - aggregate damage larger than a dime in diameter to size of a half dollar.
S - severe - aggregate damage greater than the size of a half dollar.

[2] Number of fruit used: Marsh - 3,200, Duncan - 3,109.

* - Indicates less than 1/2 percent.

TABLE 23.--Development of decay in grapefruit as effected by various combinations of storage temperatures, in simulated shipping tests at Orlando, June 1955

Temperatures and length of storage periods	Percentage of decay at end of indicated period[1]							
	Marsh variety[2]				Duncan variety[2]			
	TD	SE	Pen	Misc	TD	SE	Pen	Misc
		Percent				*Percent*		
32° F. for 3 weeks	1	(*)	0	1	(*)	(*)	0	(*)
32° F. for 3 weeks + 50° for 2 weeks	35	(*)	26	9	24	(*)	16	8
32° F. for 3 weeks + 50° for 2 weeks + 60° for 1 week	63	4	45	14	48	1	34	13
32° F. for 3 weeks + 50° for 2 weeks + 60° for 2 weeks	75	8	48	19	59	3	38	18
50° F. for 3 weeks	12	1	8	3	6	2	2	2
50° F. for 3 weeks + 32° for 2 weeks	12	1	8	3	7	2	2	3
50° F. for 3 weeks + 32° for 2 weeks + 60° for 1 week	40	7	23	10	21	4	9	8
50° F. for 3 weeks + 32° for 2 weeks + 60° for 2 weeks	59	11	35	13	42	6	25	11

[1] Key: TD - total decay.
SE - stem-end rot.
Pen - Penicillium decay.
Misc - miscellaneous decay.

[2] Number of fruit used: Marsh - 3,200, Duncan - 3,109.

* - Indicates less than 1/2 percent.

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